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TRANSACTIONS

OF THE

NORFOLK & NORWICH NATURALISTS' SOCIETY

The Norfolk and Norwich Naturalists' Society has for its objects :—

1. The practical study of Natural Science.

2. The protection, by its influence with landowners and others, of indigenous species requiring protection, and the circulation of information which may dispel prejudices leading to their destruction.

3. The discouragement of the practice of destroying the rarer species of birds that occasionally visit the County, and of exterminating rare plants in their native localities.

4. The record of facts and traditions connected with the habits, distribution, and former abundance or otherwise of animals and plants which have become extinct in the County ; and the use of all legitimate means to prevent the extermination of existing species, more especially those known to be diminishing in numbers.

5. The publication of papers on Natural History contributed to the Society, especially such as relate to the County of Norfolk.

6. The facilitating a friendly intercourse between local Naturalists by means of Meetings for the reading and discussion of papers and for the exhibition of specimens, supplemented by Field-meetings and Excursions, with a view to extend the study of Natural Science on a sound and systematic basis.

TRANSACTIONS

OF THE

Norfolk and Norwich

NATURALISTS' SOCIETY

EDITED BY THE HONORARY SECRETARY

VOL. XII.

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25 FEB 30
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The Committee beg to direct the attention of authors of communications to the Society to the following Regulations which have been drawn up in order to accelerate the publication of the Transactions, and to utilise as widely and as fairly as possible the funds which the Society devotes to the publication of scientific researches :—

1.—Precedence will be given to papers dealing with local Natural History.

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MUSEUM
29 JAN 26
NATURAL HISTORY.

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3. The discouragement of the practice of destroying the rarer species of birds that occasionally visit the County, and of exterminating rare plants in their native localities.

4. The record of facts and traditions connected with the habits, distribution, and former abundance or otherwise of animals and plants which have become extinct in the County ; and the use of all legitimate means to prevent the extermination of existing species, more especially those known to be diminishing in numbers.

5. The publication of Papers on Natural History contributed to the Society, especially such as relate to the County of Norfolk.

6. The facilitating of a friendly intercourse between local Naturalists by means of Meetings for the reading and discussion of papers and for the exhibition of specimens, supplemented by Field-meetings and Excursions, with a view of extending the study of Natural Science on a sound and systematic basis.

7. Any Member who, in the opinion of the Committee, contravenes the objects of the Society is liable to have his name erased from the List of Members.

TRANSACTIONS

OF THE

Norfolk and Norwich

NATURALISTS' SOCIETY

1924—25

VOL. XII.—Part I

Edited by the Honorary Secretary

NORWICH

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January, 1926

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C

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1919 Currie Lt.-Col. J. W., Old Catton

D

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E

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F

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1922 Ferrier R. F. E., F.S.A., Hemsby Hall, Norfolk
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1924 Fowler Mrs. E., Gunton Old Hall, Lowestoft
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G

1914 Gadesden Miss F., White Gates, Gresham, Norwich
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H

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1891 Hinde F. C., *Hon. Librarian*, 4, Quebec Road, Norwich
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K

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M

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1924 Orgill Miss M. A., Garboldisham, Diss

P

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1880 Preston A. W., F.R.Met.Soc., Christ Church Lodge, Norwich
1919 Preston Sir E., Bart., Beeston Hall, Norwich
1900 Preston F., Thorpe Mansions, Norwich
1913 Purdy T. W., Woodgate, Aylsham
1925 Purnell Mrs. Ralph, 9, The Crescent, Norwich
1925 Purnell Ralph, 9, The Crescent, Norwich
1887 Pycraft W. P., A.L.S., F.Z.S., British Museum (Natural History), London, S.W.

R

1925 Reeves Hugh, Honingham Hall, Norwich
1924 Richmond H. W., F.R.S., King's College, Cambridge
1925 Ringrose B., Wilford Rise, Bromeswell Heath, Woodbridge
1924 Rippingall Neale F., Langham, Blakeney, Norfolk
1911 Rising A. P., The Manor House, Ormesby, Great Yarmouth
1908 Riviere B. B., F.R.C.S., F.Z.S., M.B.O.U., St. Giles' Plain, Norwich
1893 Roberts E. T., 34, Carlisle Road, Norwich
1919 Robinson F., Watton, Norfolk
1869 O.M. Robinson H. S., Eaton, Norwich
1908 Rogers Commander F. S., R.N., Ingham New Hall, Norfolk
1909 Rogers Rev. Henry, Coltishall Hall, Norwich
1884 *Rosebery The Right Hon. the Earl of, K.G., 38, Berkeley Square, W. 1.
1908 *Rothermere Rt. Hon. Lord, Hemsted Park, Cranbrook, Kent
1897 *Rothschild Rt. Hon. Lord, F.Z.S., Tring, Herts.
1922 Rounce G. H., The Pines, Park Road, Cromer
1879 Royal Microscopical Society, President of the, *Hon. Mem.*, 20, Hanover Square, W.
1918 Rudd A. J., F.Z.S., London Street, Norwich
1902 *Ruggles-Brice Mrs. R., Dar-es Salaam, East Africa
1906 Rumbelow P. E., 27, Rodney Road, Great Yarmouth
1919 Russwurm Mrs., Scarning Grange, E. Dereham
1901 Rye Walter, 66, Clarendon Road, Norwich

S

1925 Sewell P. E., Dudwick House, Buxton, Norwich
1922 Shepheard Dr. Samuel, Aylsham
1924 Shepherd Miss A. M., Convalescent Home, Lowestoft
1921 Silcock Chas., 56, Southwark Bridge Road, London, S.E.1.
1919 Simpson F. T., Sheringham, Norfolk
1917 Smalley F. W., "Hawthorns," 193, Clapham Road, S.W. 9
1919 Smith Col. H. F., Didlington Hall, Norfolk
1915 Smith Mrs., Ellingham Hall, Bungay
1891 Smith W. R., Harleston, Norfolk
1909 Snow T., The Craig, Windermere
1921 Soman A. E., 37, St. Andrew's Street, Norwich
1917 Sowels Miss, Thetford
1911 Spurrell J. T., Manor House, Newton St. Faiths, Norwich
1923 Spurrell Miss M., Manor House, Newton St. Faiths, Norwich
1923 Spurrell Miss P., Manor House, Newton St. Faiths, Norwich

Elected	
1922	Spalding G., 9, St. Stephen's Street, Norwich
1921	Stimpson Edward, Sall Moor Hall, Reepham, Norfolk
1922	Sumpter Dr. B. G., Brancaster Staithe, King's Lynn
1896	Sutton W. Lincolne, F.I.C., Eaton, Norwich

T

1921	Taylor Dr. Mark R., 49, Mount Pleasant, Norwich
1921	Taylor Mrs. Mark, 49, Mount Pleasant, Norwich
1878	Taylor Shephard T., M.B., The Mount, Edgefield, Melton Constable
1921	Thain D., West Somerton, Norfolk
1886	Thouless H. J., " Corfe," College Road, Norwich
1910	Ticehurst C. B., M.B.O.U., 46, London Road, N. Lowestoft
1896	Tillett Wilfrid S., 2, Claremont Road, Norwich
1920	Todd Lt.-Col. Eardley, Mundham House, Brooke
1902	Todd R. A., B.Sc., Retreat, Elburton, Plymouth
1913	Tomes Sir Chas., LL.D., F.R.S., Mannington Hall, Norfolk
1923	Tomes Lady, Mannington Hall, Norfolk
1923	Torbell C. J., 11, Essex Street, Norwich
1910	Tracy N. 3 King Street, King's Lynn
1925	Tucker B. W., Zoolog: Dept. Univ: Museum, Free School Lane, Cambridge
1906	Turner Miss E. L., F.Z.S., H.M.B.O.U., 13, Storey's Way, Cambridge

U

1923	Upcher Rev. E. C. S., Great Dunham Rectory, Norfolk
1921	Upcher H. E. S., The Gables, Upper Sheringham

V

1880	Vaughan Matthew, The Limes, Marlborough
1917	Vincent James, Hickling, Norfolk

W

1921	Wallis Rev. M. C., The Vicarage, St. Faiths
1875	Walter J. H., F.Z.S., Drayton Hall, Norwich
1923	Walter Mrs. Cyril, Old House, Drayton, Norwich
1921	Walton Miss, 17, Camberley Road, Norwich
1923	Waterfield Mrs., Attlebridge, Norfolk
1923	Waterfield Miss, Attlebridge, Norfolk
1923	Waterfield Miss Penelope, Attlebridge, Norfolk
1923	Wenn Mrs., Ingham, Norfolk
1923	Wenn Miss, Ingham, Norfolk
1883	*Whitaker Joseph, F.Z.S., Rainworth Lodge, Mansfield
1901	Wild Edward, The Hawthorns, Eaton, Norwich
1922	Willett W. L., The Rosary, Metfield, Kent
1913	Williams Miss Margaret, 28, The Close, Norwich
1909	Witherby H. F., M.B.E., F.Z.S., 326, High Holborn, W.C.
1924	Wolsey Noel G., 15, King Street, Great Yarmouth
1923	Woolsey G. E. W., Judge's Walk, Norwich
1907	Wormald Hugh, M.B.O.U., Heathfield, East Dereham
1922	Wortley Francis, "Congham," Sheringham
1924	Wright B. D. Z., Hoveton St. John, Norwich
1920	Wyllys Hugh, " Shrublands," Southtown, Great Yarmouth

Y

1923	Young The Right Honble. Lieut.-Com. E. Hilton, D.S.O., M.P., 174, Buckingham Palace Road, S.W.
1915	Yarmouth Free Library, The, Great Yarmouth

TOTAL

Honorary Members	... ...	6
Life ,,	... ...	33
Ordinary ,,	... ...	363
		402

The Treasurer in Account with the Norfolk and Norwich Naturalists' Society, Year Ending April, 1925

I. GENERAL ACCOUNT

Dr.	£	s.	d.
1924-25.			
To Balance on Deposit	64	5	7
,, Subscriptions	152	0	0
,, Sale of "Transactions"	6	2	6
,, Sale of "Flora of Norfolk"	5	7	4
,, Special Publication Fund	41	5	6
,, Payment by W. B. F. F. for printing Report	10	0	0
,, Interest on War Stock	4	0	10
,, Interest on Deposit a/c	1	12	0
,, Balance (*deficit*)	14	12	5
	£299	6	2

Cr.	£	s.	d.
By Balance, April, 1924	0	12	1
,, Norfolk & Norwich Library—Rent of Room	6	6	0
,, Cost of "Transactions," vol. xi., part v.			
Printing, 400 copies 105 0 0			
Illustrations, blocks 8 0 0			
,, printing 19 0 0			
Covers, Envelopes, and Reprints 10 8 0			
	142	8	6
,, Printing Circulars, etc.	7	14	9
,, Postages	8	7	0
,, "Norfolk News" Company, Advertising	2	11	0
,, Expenses of Meetings	3	18	9
,, Insurance	0	13	6
,, Wreath	1	4	0
,, Assistant Secretary	5	0	0
,, Sundries	4	13	0
,, Transferred to Life Membership Fund (J. H. Gurney, Legacy)	50	0	0
,, Balance on deposit	65	17	7
	£299	6	2

II. SPECIAL PUBLICATION FUND

1924-25.	£	s.	d.		£	s.	d.
To Donations—							
R. J. Colman	10	0	0				
Anonymous	5	0	0				
Sir Hugh Beevor, Bart.	5	0	0				
Robert Gurney	5	0	0				
G. H. Gurney	5	0	0				
Dr. S. H. Long	4	0	0				
F. H. Barclay	2	0	0				
A. P. Rising	1	1	0				
Sir E. Gurney	1	1	0				
Dr. S. H. Burton	1	1	0				
F. H. Partridge	0	10	0				
Sums under 10s.	1	12	6				
	£41	5	6				
				Transferred to General Account	41	5	6
					£41	5	6

III. LIFE MEMBERSHIP FUND

1924-25.	£	s.	d.		£	s.	d.
To Balance in Savings Bank, April, 1924	43	5	11	By Interest transferred to General Account	4	0	10
,, Interest on Account	0	19	8	,, Purchase of 5 per cent. War Stock £48 18s. 5d.	50	0	0
,, From General Account (J. H. Gurney, Legacy)	50	0	0				
,, Interest on War Stock	4	0	10	,, Balance in Savings Bank	44	5	7
	£98	6	5		£98	6	5

List of Investments and Assets, April, 1925

	£	s.	d.
64 War Savings Certificates, dated 24.1.19	64	0	0
5 per cent. War Stock 1929-47 at cost	100	0	0
31 War Savings Certificates, dated 17.7.23, at cost	24	16	0
Balance in Savings Bank	44	5	7
	£233	1	7

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29 JAN 26
NATURAL
HISTORY.

ADDRESS

Read by the President, DONALD HUTCHINSON, M.D., *to the Members of the Norfolk and Norwich Naturalists' Society, at their Fifty-Sixth Annual Meeting, held at the Norwich Castle Museum, on April 28th, 1925.*

LADIES AND GENTLEMEN,

MY year of office as President of this flourishing and well-established Society terminates to-day, and before giving you the subject matter of my Address, I will briefly review our year's work and our present position.

By the increasing attendances at our monthly meetings it would appear that subjects of interest have been brought before the Society. It is not an easy matter to arrange the Agenda for these meetings—especially in advance, so that they can be printed on the sessional card sent out in September —and I hope members will co-operate as far as possible with Mr. Leney, especially in the matter of exhibiting specimens.

One of the objects of our Society is " the protection, by its influence with landowners and others, of indigenous species requiring protection, and the discouragement of the practice of destroying the rarer species of birds that occasionally visit the county, and of exterminating rare plants in their native localities." By making ourselves responsible, three years ago for the protection of wild birds throughout the county, I think I may say that we have been fulfilling our trust, at any rate as regards the avifauna of Norfolk, and I am pleased to see that an increasing number of people outside the county are supporting us in these efforts. I should like to see the names of more of our own members on the list of subscribers to the " Wild Birds' Protection Fund." How to organize protection for our rarer plants I do not quite know, except to advise all our botanical members not to divulge any localities known to them.

The Society has lost one member by death since our last annual meeting, namely, the Rev. M. C. H. Bird, of Brunstead, of whom an obituary notice, accompanied by a very striking portrait, appeared in the last part of our Transactions. I cannot let this occasion pass without making reference to

another Norfolk ornithologist, who has been recently taken from us, for although he was never a member of this Society, he was so well known and revered by many of us, that his death must be given a place in our annals. I refer to the late H. N. Pashley, of Cley ; and I do not think I am betraying a confidence when I tell you that his bird notes, extending over a period of about forty years, have been edited by Mr. Riviere and are now in the publisher's hands.

Since the printing of our last list of members we have lost one by death, fourteen have resigned, and twenty new members have been elected, so that our total membership is now approximately 400. With the last part of our Transactions, we completed the XIth Volume of an unbroken series. There is no doubt, whatever, that many members have joined the society solely with the object of getting our publications, so that I hope we shall always be able to maintain the standard of these. The "Special Publication Fund" was started some years ago to meet the greatly increased cost of printing, so that I hope those who are in a position to do so will assist this fund.

The Protozoa, Their Structure and Behaviour as illustrated by the Cinema-Camera

While pondering over the weighty question as to what I should choose as the subject of my address to you this afternoon, many things presented themselves to my mind, and I had some difficulty in making my choice. I knew not whether to take Spring as my subject—the awakening of our earth to life once again after the slumber of winter—that wonderful energy which is being given out at this time all around us—the kiss of the Prince on the brow of Sleeping Beauty re-awakening her to life, or whether to speak of the bumble bee, one of the earliest visitants to make her appearance, and to be seen visiting the willow catkin at this time of year, and to deal with the causes and factors of its great abundance last year. Or, again, whether to choose the great nuptial night of the entomological world which occurred on Tuesday, August 5th, when the whole world around one seemed to rejoice in the ecstasy of its mere life.

I put all these aside, and the subject matter of my Address will be devoted to that large Phylum of the animal kingdom known as the Protozoa—invisible to the unaided eye, save for those few exceptions that are large enough to be seen as mere specks moving about in a small film of water when oblique rays of light just illuminate them sufficiently to make known their presence.

They constitute the lowest rung of the ladder of the animal world, but for all that, they form a study at once fascinating and interesting. Single-celled animals in form and structure, analogous to the single cells composing a mass of tissue such as muscle, bone, skin, fibrous tissue, etc., yet physiologically they are analogous to the mass of cells that make up the complete animal of the higher orders.

They are, as I said, single-celled animals, and this at once differentiates them from all the higher orders which naturally fall into the great group known as the Metazoa or multiple-celled animals. They fall as a group between the bacteria or Schizomycetes on the one hand, and the Porifera or sponges on the other.

Their distribution is world-wide, they abound in all forms of water, sea or fresh, in the air, and on or in the land, at high or low altitudes.

As Ehrenberg the great German naturalist wrote in 1838, "In the clearest waters and in muddy pools, in acid as well as alkaline waters, in brooks, lakes, rivers, and seas, often also in the interior fluids of living plants and animals, abundantly in living men, and periodically borne on the dusts and vapours of our atmosphere there exists a world unknown to the ordinary senses of man, of minute peculiar forms of life."

Or as Shelley so beautifully puts into verse :—

"Those viewless beings whose mansion is the smallest particle
Of the impassive atmosphere,
Enjoy and live like man
And the minutest throb that through their frame diffuses,
The slightest, faintest motion is fixed and indispensable,
As the majestic laws that rule yon rolling orbs."

In dealing with this vast subject of the Protozoa, I can touch but lightly on this or that separate point, but yet I hope to interest you in some of the laws governing the primitive animal life of which we are treating. You and I, Ladies and Gentlemen, I venture to think, are all interested in the laws governing societies. But we do not invariably observe the analogy which subsists between the operation of these laws in the lower orders of animal life and their operation in human societies. We are agreed, for example, that the law of evolution governs the progress of animal life and orders this progress by slow and easy stages. When these stages are disturbed or hurried on by some external force we have a serious interference with the balance of things, resulting, for the individual, in death, and for societies, in revolution. I am therefore a firm believer in social evolution and not in revolution.

The profuse distribution of the Protozoa brings them of necessity into close relationship with man, and it is only of very recent years that we have discovered how closely and how intimately they affect the life of man, because we know to-day that many diseases are the direct outcome of the infection of men and animals by these single-celled forms of life.

I venture to think that many of the obscure conditions from which man suffers to-day will ultimately be traceable to the direct or indirect action of these Protozoa. It is known to-day that our crops very largely depend on the number of Protozoa existing in the soil; there is a direct relationship between the two.

HISTORY

The history of the Protozoa is of interest. It practically dates back to the time of the discovery of the microscope, i.e. about 250 years.

The credit for the discovery of the Protozoa must be given to Antony von Leeuwenhoek, a Dutchman, who published his observations in the Philosophical Transactions—Vol. XII, 1677, No. 133—p. 821. "Observations," he says, concerning little animals found in rain, well, sea, and snow water, as also in water wherein pepper had lain infused."

The following is an extract from his paper :—

"In the year 1675 I discovered living creatures in rain water which had stood but four days in a new earthen pot, glased blew within. This invited me to view this water with great attention, especially those little animals appearing to me ten thousand times less than those represented by Mons. Swammerdam, and by him called water fleas or water lice, which may be perceived in the water with the naked eye. The first sort by me discovered in the said water, I divers times observed to consist of 5, 6, 7, or 8 clear globules, without being able to discover any film that held them together or contained them. When these animalcula or living atoms did move, they put forth little horns, continually moving themselves ; the place between these two horns was flat, though the rest of the body was roundish, sharpening a little towards the end, where they had a tayle, near four times the length of the whole body, of the thick body, of the thickness (by my microscope) of a spider's web ; at the end of which appeared a globul, of the bigness of one of those which made up the body ; which tayle I could not perceive, even in very clear water, to be moved by them.

These little creatures, if they chanced to light upon the least filament or string, or other such article, of which there are many in the water, especially after it hath stood some days, they were stook entangled therein, extending their body in a long round, and striving to disentangle their tayle ; whereby it came to pass that their whole body lept back towards the globul of the tayle, which then rolled together serpent like, and after the manner of copper- or iron-wire that having been wound about a stick, and unwound again, retains those windings and turnings. This motion of extension and contraction continued a while, and I have seen several hundreds of those poor little creatures within the space of a grain of gross sand, lie clustered together in a few filaments."

Evidently he was referring to Vorticella.

Sir E. King was the first to publish an illustration of this form of life, in the year 1703.

Until the cell theory was established in 1838 it was presumed that the Protozoa possessed highly specialized organs similar

to organs belonging to the higher orders. Leeuwenhoek states that "when we see animalcula moving by vibrations of their tails, we naturally conclude that these tails are provided with tendons, muscles, and articulations, no less than the tails of the dormouse or rat, and no one will doubt that they are provided with organs similar to those of the higher animals."

Trembley was the first, in 1744, to work out the life history of a Protozoon; he describes how the young, spare forms of Vorticella leave the parent colony and commence a fresh one.

Muller was one of the earliest observers to attempt a reasoned classification, bringing order out of chaos. It was Muller who first considered the Protozoa as the simplest of all living things, and it is strange to find Ehrenberg, the famous German microscopist, reverting to the old idea of Leeuwenhoek, that these Protozoa possessed complete organs. For many years a battle royal was waged in the scientific world by the two great bodies of observers, one camp supporting Ehrenberg, and the other Dujardin, Kolliker, and others.

Meyer, in 1839, was the first to suggest that the Protozoa were single cells analagous to the cells of higher animals.

I will not go further into the interesting topic of the history of the Protozoa, but those who wish to pursue the subject and obtain a deeper insight into the historical aspect will do well to read Saville Kent's masterly work.

As a pastime I would commend this branch of Natural History to your notice. Memories of many happy days crowd into one's mind as one looks back into the past: of hunts for treasure in wayside pools, of dredging undertaken in deeper waters, of the thrills at evening time after a long day's tramp, searching through the various samples of water collected in the hopes of coming across some rare specimen. I remember specially one day snatched from work, when I started to make a tour of Norfolk. It was a glorious day early in the summer months. Starting from the south-east corner of the county, I passed through Broadland to North Walsham, Cromer, Sheringham, Blakeney, and Scolt Head, visiting all these spots and collecting samples of water from each locality, returning by Holt, Ingham, Aylsham, and Norwich. No less than sixty samples were taken in this tour, and many interesting data were collected which perhaps I may have the privilege of giving

you on some subsequent occasion. The method of collecting material is by the use of a small conical tow-net for deep water, and a dip net with bottle attached for use in shallow water. Bolting silk gauze No. 25 is what I generally use, the mesh measuring about .05 mm.

CLASSIFICATION

I have already mentioned that Muller was one of the earliest observers to attempt a classification of the Protozoa. He described no less that 378 species, of which number no less than 150 are retained to this day. But, like his predecessors, he fell into grievous errors and included in his classification many diatomes, worms, rotifers, etc.

I need not weary you with a further historical sketch dealing with the classification of this phylum of the animal kingdom; it will be sufficient for me to point out that members belonging to this group carry with them certain well-marked characteristics which naturally make them fall into certain sections. Some have the power of protruding processes of protoplasm or pseudopodia. Some possess long whip-like filaments known as flagella, others numbers of hair-like processes known as cilia. It is from all these and other characteristics that the present day classification has been developed.

I have in my opening remarks referred to Protozoa and Metazoa—single and multiple celled animals; but I have not defined the scientific meaning of the term cell, and I think at this stage it would be wise to spend a short time on this point. Roughly the cell may be defined as the fundamental unit of living matter, but this definition would immediately include micro-organisms, and they are essentially of simpler structure than the Protozoa. I think for our purpose we may consider a cell as a mass of Protoplasm, with or without a limiting membrane. This mass of Protoplasm can be differentiated into two distinct parts, the cytoplasm and the nucleus.

Minchin, I think, gives the best definition of the Protozoa. He says " the essential feature of the Protozoa as contrasted with the higher animals or plants, is to be sought in the independence and physiological completeness of the cell individual. The Metazoa are tissue animals in which the

primitive individuality of the cell is subordinated to, or has a restraint imposed upon it by, the corporate individuality of the cell aggregate. In the Protozoa the cells are complete individuals morphologically and physiologically of equal value."

It is to my mind the breaking down of that restraint imposed on the cells of the metazoa that leads to gross conditions we see at times in the individual, e.g., lesions in the body known as tumours, etc.

You have now the essentials composing the group of primitive animals known as the Protozoa, viz.,

1. A mass of Protoplasm, differentiated into cytoplasm and nucleus with or without a limiting membrane.
2. Ability to carry on a separate existence and function as a higher animal.

It is from the characteristics of this living mass of Protoplasm that we are able to build up our classification of to-day—

1. The Protoplasm is unclothed and without a limiting membrane—or has a shell-like covering.
2. They have long whip-like projections or protoplasmic threads known as flagella.
3. They live as parasites, or lastly
4. They possess myriads of small hair-like projections on their surfaces, known as cilia.

Structure and Main Characteristics of Protozoa

The Protozoa consist of a mass of Protoplasm, which may be differentiated into two distinct parts, (1) the cytoplasm, and (2) the nucleus. Protoplasm as a whole is a semi-fluid substance of a somewhat viscid character.

It is composed of a highly complex chemical combination of the following elements.—Carbon, Oxygen, Hydrogen, Nitrogen, Sulphur, and Phosphorus, Potassium, Sodium, etc.

It is this combination which enters into the formation of all proteid or albuminoid matter, and is the essential distinction between animate and inanimate matter.

Protoplasm and life are synonymous. It is important to remember that although Protoplasm is of a semi-fluid character, yet it possesses a very definite structure.

I wish you to bear patiently with me while I allude briefly to these parts—cytoplasm, etc., as I wish you to observe them for yourselves when the films are being thrown on the screen.

1. The cytoplasm may be conveniently divided into two layers, ectoplasm and endoplasm.

The Ectoplasm is essentially clear and hyaline, or may be very finely granular. Being the outer layer, and in contact with the surrounding medium, it may take on many and varied forms and functions. Becoming hardened, it assumes protective characteristics, or it may develop organs of locomotion, weapons of offence and defence, etc.

As an organ of protection we see it well-developed in forms such as Difflugia, Arcella, Dinobryon, Thuricola, etc. Here you have the Ectoplasm formed into a shell-like covering, in some cases chitinous in character, in others small hexagonal plates joined together in perfect symmetry, or again silicious.

Again, particles from the surrounding medium may be glued on to the exterior surface, forming a perfect house for retreat. Again, in other types there is a well-formed lorica, and in some cases a valve attached, which closes down when the animal retires within its house. Thus we see that the trap-door spider was not the first to think of this device. These are a few outstanding examples of the protective capabilities of Ectoplasm. It may also, however, develop active organs of defence,such as trichocysts, which are well seen in Paramoecium, etc. This process may be likened to the action of a man harpooning his prey. A still further development of the Ectoplasm creates it into what is actually an organ of offence. This is illustrated in those extensions which resemble tentacles and which are to be found in the group known as Suctoria. These extensions or tentacles are hollow tubes of the Ectoplasm, pointed or capitate in form, which are able to pierce their prey and suck their juices into their interior.

So much for the Ectoplasm. Let us now turn to the Endoplasm. Examined under high powers of the microscope, e.g. a 2 or 3 mm objective, a distinct structure is visible. It may be likened to a meshwork enclosing spaces of varying sizes. Both the meshwork and spaces are fluid in character,

but the former, being more dense than the other in composition, shows up as a mesh. They contain granules of varying size and consistence.

According to Butschli, protoplasm may be considered to consist of two fluids of different consistence—one more viscid that the other, and thus forming an alveolar framework. This he compares with the structure of foam, and just as you have a small bubble coalescing in foam and forming a larger bubble than its immediate neighbours, so you have droplets of this alveolar substance running together and giving rise to that structure so commonly seen in the Endoplasm of the Protozoa and known as a vacuole. The vacuoles are concerned in food assimilation and excretion.

These food vacuoles must not be confounded with contractile vacuoles, which belong essentially to the Ectoplasm, and always make their first appearance in this structure. These bodies are concerned with excretion. The waste fluids of the Endoplasm drain into the Ectoplasm, and there the small droplets run together forming one large sphere of fluid which ultimately bursts on the surface. In amœbæ of the non-corticate type, the contractile vacuole is carried about in the streaming protoplasm, and does not retain a fixed position as it does in those forms of Protozoa that have a distinct limiting membrane, whose contractile vacuole is always in a fixed position and discharges through definite pores.

I now come to what I consider the most interesting part of the whole structure of the Protozoan organism, namely, the nucleus. This body is generally easily recognizable under the microscope, even in the live state of the animal, as it possesses a different refractive power from the surrounding cytoplasm, but in stained specimens it is at once recognizable by its affinity for certain aniline dyes. It is composed of a semi-fluid viscid substance, to which the name nucleoplasm has been given. It may or may not have a limiting membrane, but generally has. It is usually spheroidal in shape, but may be of very varied type, e.g. horse-shoe shaped, elliptical, beaded, etc.

It consists structurally of the following parts :—

1. A clear plasma, amorphous in character, known as the achromatinic portion, embedded in

2. A fine reticular network—the linin network or nuclear reticulum which at its periphery forms the enclosing nuclear membrane.

3. A strongly staining substance in the form of granules or rods known as chromatin, often giving the appearance of a second network in addition to that of the true nuclear framework.

When these chromatin rods or granules appear to coalesce, small masses of thickened particles are formed, known as nucleoli.

During the resting stage of a cell, the chromatin of the nucleus is of a granular character. When division is about to take place, they form into rods known as chromosomes, which are always of a definite shape, size, and number for any particular species.

The nucleus exists in the Endoplasm of the organism, and is essential to the life of the cell. Many experiments have been carried out in connection with this structure, where bits of amoeba have been cut off, with or without the nucleus. It has always been found that those portions of cytoplasm that possess the nucleus are able to regenerate, while the parts cut off minus the nucleus, are able to live, and even to ingest food, for a short period, but ultimately die. On the other hand the nucleus, if dissected out of its surrounding cytoplasm, is unable to live a separate existence. Experiments have definitely proved that there is an inter-dependence between the cytoplasm and nucleus.

Another constituent which is to be found making up the cell composition, is known as the centrosome. This body or bodies, as there are generally two, may be situated outside the nucleus (as is frequently the case in a metazoan cell), or inside (this is often seen in the Protozoa), and are surrounded by a finely granular or perfectly clear mass of cytoplasm known as the attraction sphere or archoplasm. The alveolar meshwork of this attraction sphere may be arranged in what appear like bundles of fibres radiating outwards from the centrosome. The centrosome is an important structure in cell division.

I cannot now spend time in giving you further details of all the changes that go on in the nucleus and centrosome during the division of a cell. I must refer you to the text books for a study of this subject.

We must now consider the conditions under which these animals exist. By far and away the majority live in water, either salt or fresh.

We will confine our attention to their habitats in fresh water only, as it is this aspect of the subject with which I am most intimately connected. The study of this branch is known scientifically as limnology, from the Greek word *limnos*, a marsh or pond, and I can safely say without fear of contradiction that there is no part of the British Isles more suited for carrying out investigations than the counties of Norfolk and Suffolk. With their wide distribution of water ways and the marsh lands immediately surrounding them, they are ideal.

At first sight it might appear to you that there is not much in the subject, but I would advise you not to form too hasty conclusions.

Water, as deposited on this globe, comes in the form of either rain or snow, and is distributed on the land, in lakes or ponds, the more stable forms of water collection (truly limnological), or it finds its way into the unstable forms of water such as streams and rivers, rheological. A large proportion of the water before finding its way into the sea, either evaporates or percolates into the deeper layers of the Earth's crust.

In dealing with the stable forms of water, such as puddles, ponds, or lakes, many factors come into play which have a direct influence on the amount of life to be found in them, e.g., temperature, light, surrounding country, wind, etc. There is also a direct relationship between the amount of life in a mass of water and its depth. For instance, in a shallow lake exposed to the action of wind, there is a constant agitation of the surface, and therefore a certain amount of circulation established. This of course means a more perfect aeration than takes place in the deep lakes, where it is only the superficial layers that receive proper aeration.

Temperature plays a very important part in the animal life of a lake, affecting not only the Protozoa but also the higher orders. In the summer there is generally an upper warm layer, known as the Epilimnion, and a lower cold layer, known as the Hypolimnion. Between these layers there is a constant circulation, induced by the differences of temperature, which

brings about a proper aeration of the mass of water and thus helps to produce conditions suitable for the life of the Protozoa.

In very shallow lakes or ponds, where the temperature of the water is the same throughout, the aeration is produced by the action of the wind.

Light also naturally plays as very important part in the lives of animals and plants. The depth to which light penetrates depends on the turbidity of the water. In the open sea it has been found to penetrate as low as 1,000 metres, but not beyond 1,700 metres. It is well known that many crustacea are found at different depths at different times of the day, adopting a regular cyclical change, according to the intensity of light. So it is with the Protozoa.

Protozoa are affected by lights of varying quality, but as a class they are not affected to the same extent as other animals. According to Jennings, most colourless infusoria do not show any reaction ; on the other hand certain of the coloured forms show either a positive or negative photo-pathic tendency. (An illustration of a positive form, *Euglena viridis* ; a negative form, *Stentor caerulens*). I have frequently witnessed a positive tendency in Volvox, and on the other hand Thuricola shows a strongly negative tendency.

One constantly encounters great difficulty in obtaining suitable cinema films of Protozoal behaviour on account of this action of light. Many a time I have struggled a whole evening trying to obtain a satisfactory exposure with Thuricola in the field of view, but have always up to the present time met with failure. I think one of the ways to get over this difficulty will be to use a fast panchromatic film and monochromatic light.

It is essential in all successful photo-micrographic work to have a strong and powerful illuminant and, for choice, I always use an electric arc light. To obtain the best results it is imperative to see that the light given out from the crater of the arc fills the whole of the back combination of the objective.

Can we trace in the Protozoa any of the more specialized characteristics seen in the orders of the higher phyla of the animal kingdom. ? In my earlier remarks I stated that physiologically the protozoan cell was analagous to the complete mass

of cells composing a metazoan; but in the metazoan are developed many different functions, the performance of which is carried out by different masses of cells.

There is no nervous system in the Protozoa, yet are they able to function as the Metazoa? Do they in fact, re-act to stimuli in the same way? We can answer this in the affirmative as Jennings states "there is no evidence of the existence of differences of fundamental character between the behaviour of the Protozoa and that of the lower Metazoa. The behaviour of the Protozoa appears to be no more and no less machine-like than that of the Metazoa . . . The possession of a nervous system brings with it no observable essential changes in the nature of behaviour . . . It is doubtful if the nervous system is the exclusive seat of anything—its properties are accentuations of the general properties of Protoplasm."

The behaviour of higher animals depends on physiological states; the effect of cold, heat, light, electricity, chemicals, etc., produces definite reactions, similar stimuli produce similar reactions in the Protozoa.

Again in higher animals you have developed subjective states, memory, reason, pain, perception, etc. Can we by analogy tend to prove that the same states exist in the Protozoa? Jennings in his series of experiments on many of these animals, goes a long way I think, to prove that they do exist. He shows that Stentor, fed on carmine grains, will at first take them quite readily, but if the stimulus is continued, it will bend off in another direction, attempting to find an area where the stimulus is not present. If the stimulus is still further continued, it will ultimately retract itself until such time as the stimulus is removed. If within a given time the experiment isrepeated, the animal does not go through the evolutions above described, but will immediately retract itself, exhibiting the subjective sense which we term memory.

Amoeba in the same way may be shown to exhibit the sense of discrimination over a grain of sand or a euglena cyst. I shall hope to show you the sense of fear, in my film of amoeba. When the film is being shown, if you will carefully watch the part which shows an amoeba that has engulfed two Protozoa,

I think you will clearly make out a feverish desire on the part of these animals to escape from their prison, thus exhibiting a sense of what we may term reason, if not fear. Such reflexes as I have mentioned, both objective and subjective, are the beginnings of what may be termed instinct.

The functioning of the mind is frequently reflected in the body, by the action of the various members composing it. Man possesses the most highly developed set of members, yet it is possible to trace in the Protozoa the beginnings of development of these members.

Amoeba, the simplest of all Protozoa, possesses no mouth, no eye, no legs, or arms. Movement from one spot to another is simply carried out by a flowing of the Protoplasm, and these extensions from the general mass of the animal are known as pseudo-pods or "false legs." Feeding takes place by a simple process of engulfment of the food particle by the Protoplasm flowing round it. I shall not be able to show you on the films a Protozoon actually feeding, but you will see well illustrated the flow of the Protoplasm.

The most primitive type of limb formation is to be seen in the hypotrichous type of infusorion, e.g. Stylonichia. Here you get a number of cilia, massed together into bundles scattered over the ventral surface of the animal, being used as legs, and very good legs they make too, as anyone knows full well who has studied these particular animals and watched the wonderful way they are able actually to walk about on the surface of weeds, etc. Again with the eye, you find the earliest development of this wonderful organ in forms of of flagellata known as euglena. Those forms that show a positive photo-taxis or attraction to light possess a special organ known as the eye spot or stigma. Finally in regard to the mouth parts. In amoeba you have simple engulfing of food particles by Protoplasm flowing round them and just absorbing them into the Endoplasm. The first development of a mouth consists of an oval or round opening, lined by cilia, leading into a tube analagous to the gullet which terminates abruptly in the Endoplasm. The next stage of evolutionary development consists of a series of rods situated in the gullet, which are able to open and close the mouth.

I have hitherto spoken of the Protozoa only in its individual aspect, but before concluding I may refer to its capacity for living as a member of a group.

One of God's greatest laws is that men should live together and not alone; the isolated man becomes a selfish man. Communal living amongst ants and bees is indeed brought to a high state of perfection, but even on the lowest rung of the ladder of animal life we find this law coming into operation, as in Vorticella, Zoothamnium, Epistilis, and Carhesium.

A mutual existence is constantly to be found among forms of the Vorticellidae and members of the Crustacea; or again between Trichodina, Pediculus, and *Hydra vulgaris* or *viridis*. These are just two examples of mutual aid.

It has been no easy matter to take these films of Protozoal life. There have been many difficulties, the most important being the fact that one might be reeling off yards of film without having any organism in the field of view. To overcome this difficulty I have at length devised an instrument, which I cannot conveniently describe here, but which has enabled me to reel off the film, not haphazardly but only when there is an animal in the field of view.

And here, Ladies and Gentlemen, I may conveniently put forward the only plea I have for what may seem to you the inadequacy of the Presidential Address, its shortcomings, both in style and substance. I am but little accustomed to the practice of popular exposition; and if my literary illustrations are wanting in vividness or freshness, and if much of the substance of what I have had to say can be found in the standard works on the subject, yet I have reason to hope that the film I am about to exhibit to you may seem a contribution to this study not unworthy of the occasion of a Presidential Address. It is the film illustrations, far more than any comment that can be made on them, that I present to you as the fruit of my work—work spread over the past several years, involving many a night of patient and often fruitless vigil over the microscope, as well as many an hour spent in devising mechanical contrivances to overcome the difficulties to which I have alluded. It is this kind of labour to which I am accustomed, rather than to that of excogitating Presidential Addresses, and it is the fruit of this labour that I offer in mitigation of any

criticism of my halting exposition of this vast subject, May I hope that, when you have seen the film and when you have reflected on the difficulties of producing it, you will be indulgent enough to pardon the lameness of the introduction.

Following the address films were shown illustrating various forms of Protozoal Life, e.g. Amoeba, Volvox, Vorticella, and Paramaecium.

II

THE SWAN-ROLL IN THE NORWICH CASTLE MUSEUM

By N. F. Ticehurst, O.B.E., M.A., F.R.C.S.

By the courtesy of Mr. Frank Leney, the Curator of the Norwich Castle Museum, an opportunity was afforded me last year to make a copy of the marks and names recorded on the Swan-roll in his charge, and since then I have spent a considerable amount of time working on it. To one well-acquainted with what has been written about it in Stevenson's *Birds of Norfolk* (III. pp. 105-6), the results are rather surprising, and consequently it may not be without interest to relate them here.

Before passing to a description of the Roll itself, it will be perhaps as well by way of preface, to make a few remarks on Swan-rolls in general. I have now examined and made copies of some nine and twenty of these ancient records, ranging in date from about 1490 to 1670. Of these, nine relate to districts in Eastern Norfolk that may be roughly referred to here as the Broadland area, so that a considerable amount of material has been available with which to compare the present roll. From a study of these, two main points are clear, (1) that almost certainly the vast majority of rolls now extant are copies of more ancient documents, sometimes more or less brought up-to-date at the time of copying, and with or without later additions ; (2) that many ancient marks and names were copied on to fresh rolls, long after the owner's

named had passed away. Of course it is obvious that a game of swans, marked with a particular mark, did not cease to exist at its owner's death, but might, and no doubt did, continue through two or even many human generations. It would thus seem to have been the custom to designate certain marks by the names of their earliest owners and to copy them from roll to roll accordingly, even though several changes of ownership might have taken place in the meantime. For instance, the marks of religious houses, their abbots and priors, are constant features of all rolls up to, at any rate, over a century after the dissolution of the monasteries. An attempt therefore to fix the date of any particular roll becomes a task of some difficulty and complexity; but, shortly, apart from the evidence of handwriting, which of course is a useful guide, the only safe plan is to take for the earliest date at which the copy could have been made the latest date that can be determined from a consideration of the histories of the individuals whose names are recorded, provided of course that the names are original to the roll and not later additions. It will be seen how this works out in the present case.

The present roll consists of a handsomely bound large folio of vellum leaves, which, if joined top to bottom, would form a continuous roll, containing a double column of swans' heads, those exhibiting marks covering six and a half pages. There are eight heads on each page, drawn in profile and facing inwards. The drawing of the heads, though not overtrue to nature, is distinctly modern and artistic, both in character and execution, and quite unlike that of any of the ancient swan-rolls. The feathering of the heads is indicated by shading in brown and grey, the eye is gilded, the bills are drawn partly open and gilded, while the gape is coloured red. The marks are drawn in black and extend in several instances across the gape on to the lower mandible ! an absurdity that prompted Stevenson (*loc. cit*) to question the fact that the roll was a *faithful* copy of an older one. The owners' names are written in Roman capitals in black under each head.

In working out the history and date of this roll, there are five facts and a supposition to consider. The facts are :—

(1) A roll of Norfolk swan-marks was executed in 1598.

(2) The Corporation of Norwich owned a roll of swan-marks in 1846.

(3) A copy of this roll was made by Mr. Ninham, of Norwich, in 1846.

(4) The present Museum roll is this copy.

(5) The original disappeared between 1846 and 1857.

The supposition (Stevenson *loc. cit.*) is that the rolls (1) and (2) were the same, and that therefore (4) is a copy of (1).

(1) The existence of a swan-roll executed in 1598 rests on the statement by Blomefield (*History of Norfolk* vol. 1. 8vo., p.170, as quoted by Stevenson)—"upon which statute [22 Ed. IV. c. 6.] an account of all the swan-marks in this county was taken and entered in a roll, which was renewed in the year 1598, when the order for Swans was printed; the city being then seized, according to the swan-rolls, of three swan-marks." It is to be noted that in the present roll, the corporation is credited with four!

There is not a word here about this roll being made for, or being the property of, the Corporation, and, seeing that an enrolment of all the swan marks in the county is specifically mentioned, it is not probable that it was. The Corporation could have no possible interest in swans outside the waters in which their own were swimming; they were at that date in exactly the same position as other private owners, and the enrolment of the marks and the keeping of the roll were the special duties of the County Swan-master.

There is of course the possibility that this roll may have come into the possession of the Corporation in after years.

(2 and 3) That the Corporation of Norwich possessed a swan-roll in 1846, is proved by the fact that it was exhibited, together with Ninham's copy, before the Norfolk and Norwich Archæological Society in that year (M.S. Proceedings and *Norfolk Archaeology* I. pp. 371, as cited by Stevenson), also by Stevenson's statement as follows:—"This copy was fortunately made at the suggestion of the late Mr. Thomas Brightwell to provide against the possible loss of the original, but when completed the Town Council declined to purchase it at the sum named by Mr. Ninham, and it subsequently passed into the possession of Mr. Osborne Springfield, of Catton."

(4) The present roll came into the possession of the Museum in 1877, when it was presented by Mr. Jeremiah James Coleman. The entry in the Museum Register reads as follows :—" A facsimile copy on vellum of the Corporation of Norwich Swan Marks, as made by Henry Ninham from the original roll in 1846, and afterwards sold to the late Mr. Springfield, at whose sale in 1877 it was bought by J. J. Coleman Esq., M.P.

(5) Writing of the disappearance of the roll exhibited in 1846, Stevenson (*loc. cit.*) states that " Mr. Mendham, who has filled the office of Town Clerk since 1857, assures me that he never had this roll in his custody."

Stevenson's supposition that the roll exhibited in 1846 was the roll executed in 1598, is contained in the final paragraph on p. 106 (*op. cit*). " The copy contains about 46 distinct marks . . . and from these . . . I propose making selections for an additional plate, should the roll of 1598 not be recovered by the completion of this volume."

On p. 105, after enumerating the owners of the marks given by Blomefield on his plan of the City of Norwich (*History of Norfolk, vol. IV.*), Stevenson also makes the following remark " There is little doubt, I think, that the marks thus figured by Blomefield were taken from the ancient swan-roll of 1598, to which he alludes in his remarks on the statute of Edward IV." This supposition is either incorrect, or Ninham's roll is not a copy of the 1598 roll, as Blomefield's plan contains two marks (for the Cellerer of St. Bennet's and for the Corporation of Norwich) that are not present on Ninham's copy, while the Rokel's manor mark, and the Prior's two marks are differently drawn. By his reference to the City's three marks ([1] above) Blomefield seems to have been acquainted with several swan-rolls, but there is no evidence that he had seen this particular roll of 1598.

It may presumably be taken for granted that Ninham's copy is a faithful reproduction of the roll that was owned by the Corporation in 1846, otherwise there would have been no object in making the copy. This being so, was this the roll of 1598 ? If it was not, what was it ?

If Blomefield's original description of the 1598 roll, in which he states that it contained *all the swan-marks used in Norfolk*

at that date, is correct, the roll owned by the Corporation in 1846 cannot be it, for it does not contain a sixth part of them. This fact was really brought out by Stevenson (*loc. cit.*), when he remarked that the copy contained " about 46 marks now or formerly *used on the Yare and Wensum* " (italics mine), though he did not notice the discrepancy.

For further evidence, the contents of the roll itself must be considered and comparison made with other Broadland rolls of 16th and 17th century date.

For the sake of easy reference, the left and right hand columns of heads have been lettered " A " and " B " and the successive pairs have been numbered from the top downwards.

In the first place there are 51 marks, but these include three pairs of duplicates, leaving 48 different marks, and these may be divided into four separate divisions :—

(A) Four marks were not originally Broadland marks at all, but belonged to the Fenland area. They are to be found on most Fenland rolls of Elizabethan date, and can easily be distinguished from Broadland marks by their greater complexity. It is not easy to account for their presence on this roll at all, though it is possible that the owners may have transferred their swans at a later period from one side of Norfolk to the other. These marks are :—

2A. " Shipworth," by which no doubt Skipworth is meant. This was the mark of the Skipwiths of Snore Hall in Fordham. Burke remarks that the spelling of the name was altered by some branches of the family to Skipworth, about 1725.

2B. " Roper Sandell." This was the mark of the Saudells of Saham Toney.

3A. " J.S.N.N. Shipworth." This is the old mark of the Priors of Thetford, and, later, one of those of the Dukes of Norfolk, and according to Martin (*History of Thetford*, p. 293) was in 1779 Lord Petre's. It occurs in Fenland rolls under one or other of the first two names. Incidentally, people with four christian names did not exist at the end of the sixteenth century !

3B. "Watts." This mark is given on every Fenland roll for Thomas Watts of Mattishall, or for an earlier owner, John Bull of Hockwold.

(B) Next there are 10 marks which belonged to the owners named in the present roll before the Reformation, and which appear to have been in use and known by the names of their early owners for many years after. These are :—Norwich Hospital, 5B. ; St. Bennet's Abbey, 6B. and 24A. ; the Abbot of St. Bennet's, 25A. ; Blacke of Trowse, 7B. (sometimes known as the mark of Rokel's manor, and later as the Hospital's) ; the Convent of Christ Church, 8B. ; the Priory of Carrow, 20B. and 22A. ; the Priory of Norwich, 23A. and 25B.

Some or all of these are to be found on every Broadland roll of 16th and early 17th century date, and are therefore of no value in assessing the date of the present roll.

(C) Five marks that certainly date from the 16th century and are perhaps as old as those under (B). These are : — The Bishop of Norwich, 19A. ; Norwich, 7A. ("Robert Norwich" in 16th century rolls) ; the Corporation of Norwich, 14B. (Martin Sidley of Morley, circa 1600 in early 17th century rolls) ; the Duke of Norfolk, 9B. ; and John Topy, 8A. (both under the same ownership in early 17th century rolls). The Bishop's and the Duke's marks are of course instances of continuing ownership ; the other two appear to be further instances of marks retaining their early owners' names, like those under (B).

(D) The remaining 30 marks consist of two unnamed, two for the Hospital, one for the Bishop, one for the Mayor, three for the Corporation, and 21 for private owners. From a study of these last, the following points emerge :—

(1). None of the marks are to be found on Broadland rolls of 16th or early 17th century date.

(2) With the exception of the Duke of Norfolk, Berney, and Morse, none of the private owners' names occur on Broadland rolls of 16th or early 17th century date.

(3) The marks given for these three families are entirely different from those owned by them in the 16th or early 17th century.

(4) A John Hall of Barsham, a John Harvey of Fawkenshall, Suffolk, and the Gilbert and Berney families (but no *William* Gilbert) occur in the Visitations of Norfolk (1563-1613), but, with these exceptions, not one of the private owners belonged to a visitation family, or is to be found amongst their marriage connections.

(5) Except for the marks of private owners mentioned above under A. B. and C., there is a total absence on this roll of both names and marks that are found constantly on Broadland rolls of 16th and early 17th century date.

(6) No marks are recorded in the present roll under manorial names, which is also a constant and unique feature of Broadland rolls of 16th and early 17th century date.

The conclusion to be drawn from these is that the roll cannot have been compiled before 1650.

It remains to consider what information can be gathered from the histories of such private owners as can be traced.

10.A. "Lord Roseberry." Archibald Primrose (1661-1723) was created Baron Primrose and Dalmeny and Viscount Rosebery in 1700, and Earl of Rosebery in 1703. The title is of course still extant.

11.B. "Lord Suffield." Sir Harbord Harbord, 2nd Bart., was created Baron Suffield in 1786. This title is also still extant.

12.A. "John Harvey" of Thorpe Lodge, b. 1755, d. 1842, was the son of Robert of Catton, who was the son and grandson of other Roberts.

13.A. "Sir A. Berney." The first baronet of this family was Sir Richard, created in 1620 and his successors in order were Sir Thomas (1668-1693), Sir Richard (1693-1706), Sir Richard (1706-1710), Sir Thomas (1710-1742), Sir Hanson (1742-1778), Sir John (1778-1825,) Sir Hanson (1825-1870,) "Sir A." therefore must be an error, most probably for Sir H.

15.B. "Lord Stafford." There were two creations for the Howard family, (a) William (1614-1680), 5th son of Thomas, Earl of Arundel and Surrey, was created Baron Stafford in 1640, but was attainted and executed in 1680; (b) his son Henry was created Earl of Stafford in 1688, but this title became extinct on the death of the 4th Earl in 1762. The Barony of 1640 was restored to Sir George William Jerningham of Costessey Hall in 1824.

16.A. "N. Mickelthwaite." A Sussex family of whom the first Norfolk member was John of Beeston, who died in 1799. His son, Nathaniel of Beeston, was born in 1760 and died in 1786, and so is unlikely to have been a swan-owner. The latter's son was Nathaniel of Taverham, b. 1784, d. 1856.

16.B. "John Morse." There are three possible owners of this name; (a) John of Hickling and Norwich, 1709-1779, son of Thomas of Glenham and Great Yarmouth, and father of John South Morse of Thorpe-by-Norwich; (b) John b. 1745, married 1775, Alderman and merchant of Norwich, son of Francis of Great Yarmouth, and nephew of John (a); (c) John of Sprowston Hall, b. 1776, d. 1844, son of John (b).

18.B. "Thomas Tuck" bought Surlingham Manor in 1815. He died in 1835 devising it to his son, C. E. Tuck.

24.B. "William Gilbert" of Cantley, was one of the five sons of Thomas of Chedgrave, who died in 1759. William bequeathed Cantley to William Henry (1774-1832) the second son of his youngest brother Henry.

26.B. "The Dowager Lady Suffield." This must have been Mary, widow of the 1st Baron, who was Dowager from 1810 to 1823, or Caroline, widow of the 2nd Baron, who was Dowager from 1821 to 1850. The swan-mark itself "C.S." makes it quite certain that it was the latter.

Consideration of the evidence afforded by the above furnishes an inevitable conclusion that the roll cannot have been compiled before 1825.

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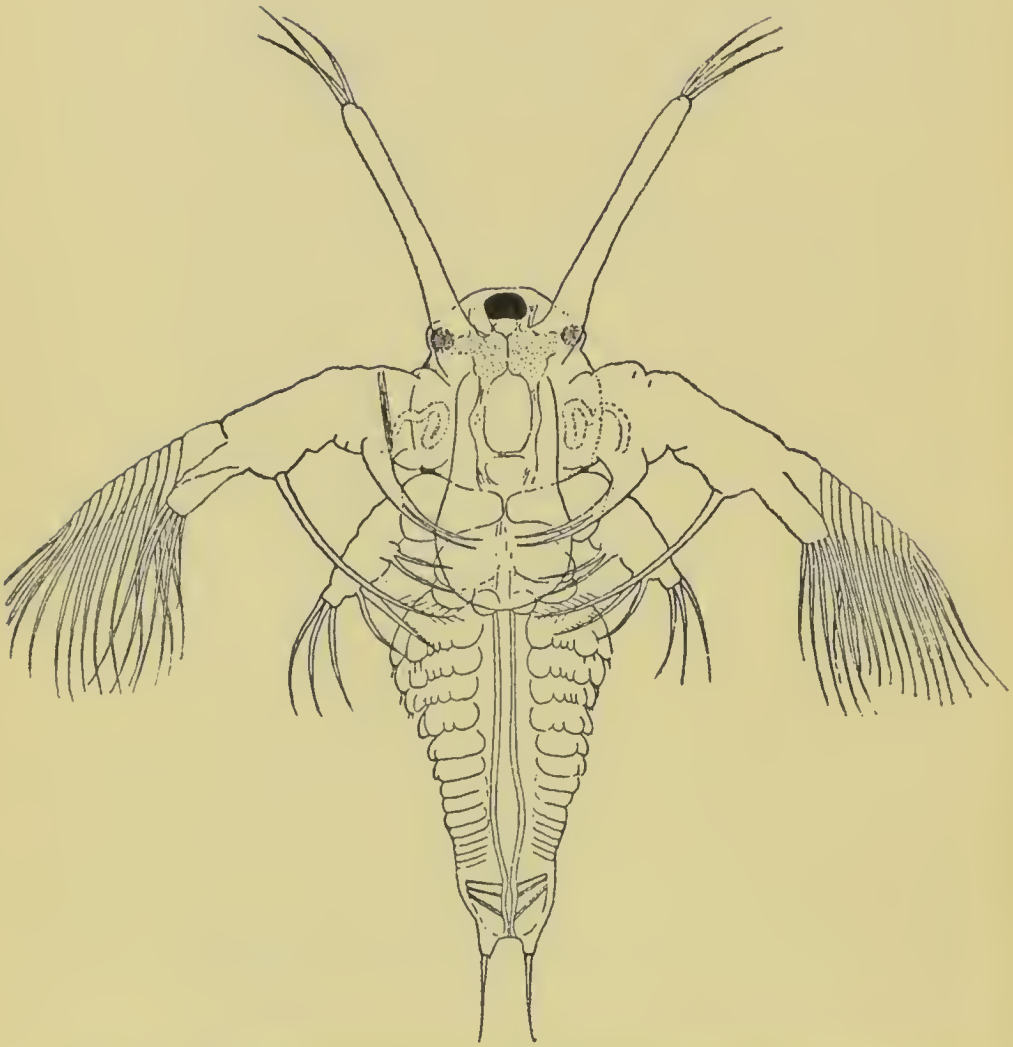

FIG. 1. NAUPLIUS LARVA OF CHIROCEPHALUS DIAPHANUS HATCHED FROM MUD

Since the above was written, Dr. Long has kindly forwarded for my inspection a series of tracings from a book of swan-marks, preserved in the strong room of the Mayor's Parlour at the Guildhall, entitled :—

"Swan marks of 1846. Presented to the Corporation of Norwich by Harry Bullard, Sheriff 1877."

Comparison shows it to be an absolute facsimile of the copy made by Ninham, and now at the Museum.

III

THE REARING OF CRUSTACEA FROM DRIED MUD

By Robert Gurney

The keeping of fresh-water aquaria is a fascinating and popular hobby, and my purpose is to advocate a kind of aquarium culture which is not so well known as it deserves to be. Before, however, proceeding to show how an aquarium may, by means of a little dried mud, be stocked with animals from distant countries, some introduction is necessary to explain how such a thing is possible.

The animals of fresh-water have two special vicissitudes to contend with, namely, frost and desiccation, which do not appreciably affect the inhabitants of the sea, and many of them have evolved special methods for meeting these dangers. Some, such as certain fishes and Amphibia, are known to burrow into the mud during a period of drought, and to survive in a state of suspended animation ; but among the invertebrates winter, or the drying up of the water, often causes the death of the whole adult population, the species being maintained by the production either of a special type of egg, or of bodies of the nature of buds which are resistant to both frost and drought. Some Rotifers are able to endure desiccation, while the young stages of some Copepods (*Cyclops diaphanus*) can survive in dried mud and may revive after considerable period of drought ; but it is more usual that special resting bodies are produced.

The Sponges produce, on the approach of winter, numbers of minute bud-like bodies or gemmules, which are enveloped in a tough coat and a layer of spicules, and these gemmules survive the death of the parent sponge and also provide for the wider dissemination of the species. The Polyzoa produce resting buds called statoblasts, which are often provided with a ring of air-filled cells and sometimes also with hooks, so that they not only float on the surface and are thus dispersed, but also readily attach themselves to the plumage of birds and may be carried to great distances.

The great majority of small Crustacea of fresh water produce, at certain seasons, eggs of a special type, which can stand desiccation for extremely long periods. Sometimes these eggs are enclosed in a modified part of the shell of the parent, which floats when cast off at the moult, like the polyzoan statoblast.

It is to these resting eggs, or buds, that some of these animals owe their immensely wide distribution. Rotifers seem to be completely independent of all barriers to distribution, and the same species occur in similar pools in England and Australia ; while one Polyzoan, *Plumatella princeps*, is found in almost every continent in the world. These animals have therefore not only overcome two of the greatest dangers to which they are exposed, but have seized the opportunity for extending their range.

This faculty for producing resting eggs has given to zoologists a great opportunity for studying in aquaria in their own homes many of the fresh-water Crustacea of distant countries. It is only necessary to obtain a sample of dried mud from the bottom of a pool which contains, or has contained, Crustacea, and to put this mud in water, for us to hatch out from the resting eggs contained in it representatives of many different kinds of Crustacea. It is upon such " mud cultures " that much of our knowledge of the smaller exotic fresh-water Crustacea is founded, and it is naturally much better to be able to examine the animals alive and to watch their habits than to receive collections of preserved specimens.

I have myself at different times had aquaria at Ingham stocked with Crustacea from Algeria, Egypt, Palestine, India, and Australia, and the method has even been useful in studying the Crustacea of our own county. For example, some years ago, I

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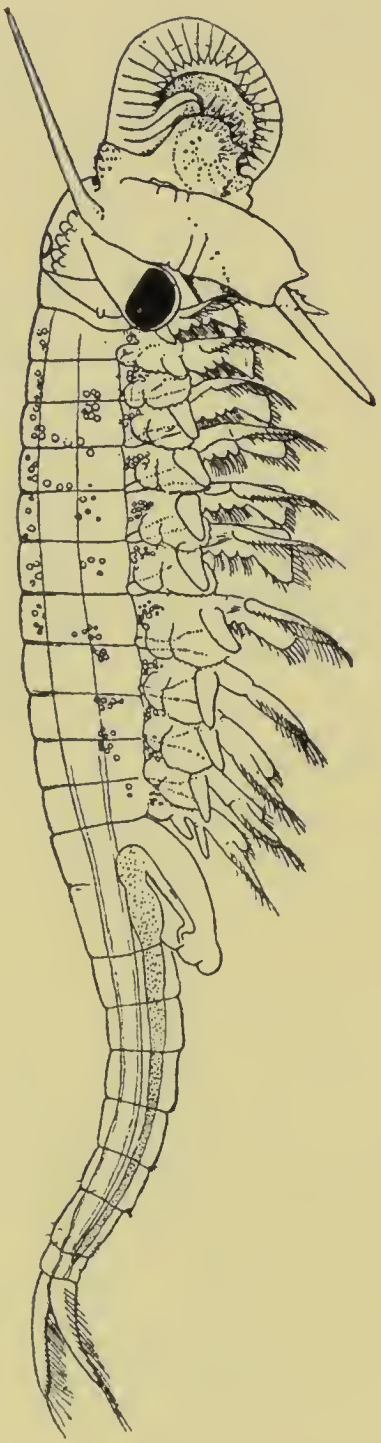

FIG. 2. ADULT MALE OF CHIROCEPHALUS DIAPHANUS REARED FROM MUD FROM PALESTINE

took some mud from the bottom of Drymere, near Swaffham, it being then quite dry and covered with grass, and from that mud hatched a species (*Macrothrix hirsuticornis*) which is of the greatest rarity, and had only once been found before in Norfolk. The animals lived and multiplied for over a year, and many male specimens appeared in the autumn. The male of this species has hardly ever been seen: I have taken it myself in Algeria, but know of no other record of it.

Again, I once collected some dry débris from the edge of Langmere and put it in an aquarium, with the result that a number of specimens of the beautiful Polyzoan *Lophopus crystallinus* hatched from statoblasts, while there also appeared large numbers of a very remarkable Rotifer, *Pedalion mirum*, which so far as I know, had not at that time been recorded as occurring in Norfolk. Before this experiment, I was unaware that either of these species lived in Langmere.

If it be objected that mud cultures can only be of interest to those who make a special study of microscopic fresh-water animals, I should reply that some of the forms which hatch are by no means microscopic, and some are very beautiful. Take, for instance, *Chirocephalus diaphanus*, the Fairy Shrimp. This is a rather transparent animal about $\frac{3}{4}$ inch in length, with bright red bristles at the end of the tail, and it is constantly swimming about on its back by undulating movements of its eleven pairs of legs. It is a very rare British species which was found near Norwich in 1762, but has not been seen in the county since. I have had a number of them alive for three years in succession, the original parents having been hatched from mud received from Palestine. Each winter the aquarium is emptied and the mud dried, to be put in water again in the following spring. Unfortunately, this year the aquarium was for a time invaded by a growth of green alga, which killed all the Chirocephalus except one, so that the strain will now die out. It is particularly interesting to examine the eggs under the microscope when they are about to hatch. The egg is enveloped in a tough brown case which bursts some time before the larva hatches, and the larva can be seen struggling within a transparent egg-membrane, which it finally breaks through. It hatches as a "nauplius" and Fig. 2 shows it after a few moults, when rudiments of some of the legs are visible.

Apus is a much more difficult animal to rear, but is particularly interesting. There are a number of species, some of them about two inches long, and they are remarkable for having about sixty pairs of legs. One species, *Apus cancriformis*, has, on very rare occasions, been found in England, the last time by Mr. F. Balfour Browne in Dumfriesshire. It lives only in muddy pools which dry up in summer.

The easiest of all these larger Crustacea to rear is Estheria. Species of Estheria are always small, seldom larger than $\frac{1}{4}$ inch long, and the body is almost entirely enclosed in a bivalve shell, so that when at rest the animal looks like a small mollusc. It swims readily, however, rather after the manner of a large Daphnia, to which it is closely allied. An aquarium in which a number of Estheria are living generally becomes very turbid, since the animals crawl about on the mud and stir it up in search of food.

I have mentioned and given figures of these few examples of animals which may be reared from mud in the hope that members of this Society may possibly be induced to try this mud-culture. The first thing is to get the mud. Anyone with friends in South Africa, Australia or India, for example, might do really useful work by getting such friends to send them a small packet of mud from a dried up pool. One of our members, Mr. F. L. Berney, has sent me mud from Queensland, from which quite a number of species have been hatched, some of which are certainly undescribed. It is essential that the mud be dried before packing—not baked of course, but thoroughly dried. No attempt should be made to start aquaria in the winter, but it would not be a bad plan to get the aquaria going early with a little ordinary garden mould, for in this way the water will become " seasoned " and Protozoa and Rotifers may appear and serve as food to the Crustacea later on. The mud-culture of Crustacea can then be started in April or May if the weather is warm. For aquaria the most convenient vessels are bell-jars about 8 inches in diameter, preferably with a flat bottom, and the knob resting in a hole in a block of wood. Finger-bowls are not bad for small aquaria, but are too small for the larger forms. Fill the aquaria with tap-water or with rain water strained through a cloth, to remove any Crustacea which might already be in it, and let them stand

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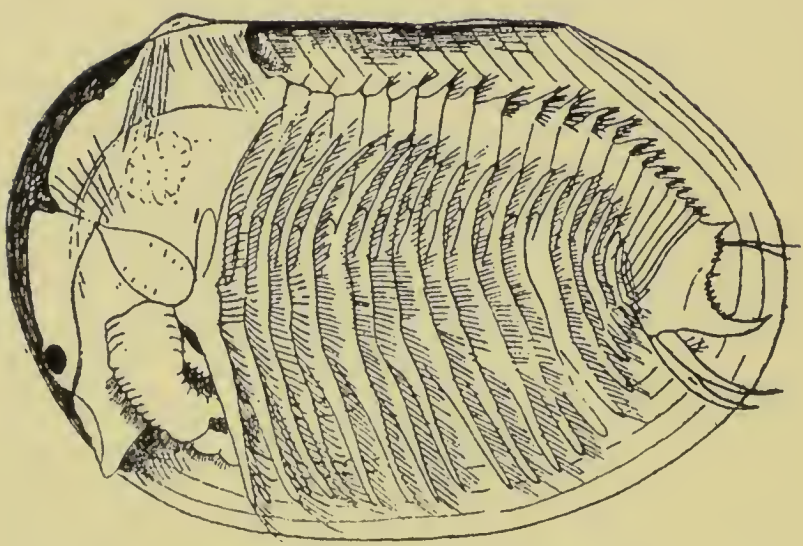

FIG. 3. ESTHERIA SYRIACA
REARED FROM MUD FROM PALESTINE

a day or two in a good light, but covered with a sheet of glass to keep out dust ; then put in a little of the mud and await results. In a week's time, or earlier, the minute larvae should appear, and if nothing, however small, shows up in about a fortnight, it will probably be best to empty out the aquarium and start again. My experience is that there are many failures, for which it is difficult to account. It is not advisable to put weed into the aquarium unless the mud is known to come from a weedy pond. The larger forms mentioned live in weedless waters as a rule, and some cannot live in the presence of weeds.

If the water becomes rather opaque and turbid it is generally a good sign that microscopic life has established itself and there is food for the Crustacea ; but if it remains absolutely clear the probability is that there is something wrong with the culture. There is always a danger in using tap-water that aquaria may fail, the reason possibly being some slight trace of lead derived from the pipes.

The smallest Crustacea, the Cladocera, and Ostracoda, reproduce during most of the year by parthenogenesis, so that a single specimen hatched out can fully populate an aquarium. When a good number have appeared, some should be caught with a pipette and preserved in formalin or alcohol for examination and identification.

The larger forms (Branchiopoda) for the most part reproduce sexually, and also their eggs do not develop at once, but are shed when the animal moults and lie in the mud. The animals should therefore be kept alive as long as possible in order that plenty of eggs may accumulate. Finally the parents may be preserved, the aquarium emptied, and the mud dried and kept till next season. The result should be the hatching of great numbers of young whose changes as they grow up may be followed under the microscope, and will afford much interest and perhaps results of scientific importance.

IV

NORFOLK HERONRIES

By B. B. Riviere, F.R.C.S., F.Z.S., M.B.O.U.

In the following paper, I do not propose to mention those Norfolk Heronries which, from time to time, have fallen into disuse, and are no longer occupied, an account of which would entail a great deal more research than I have, unfortunately, the time to give to the subject. Nor is it my intention to give more than a brief history of those which are occupied at the present time. My object has been to draw up as complete a list as possible, of those Heronries which are in existence in Norfolk to-day, which may perhaps prove of use to some future student of the history of Norfolk Heronries, and from which a fairly correct estimate may be made of the present status of the Heron as a breeding species in the County.

Should the reading of this paper elicit information as to any occupied Norfolk Heronry of which I am unaware, it will, so far as I am concerned, have served its purpose.

Bressingham.—A single pair of Herons nested in 1924 in an oak tree in the grounds of Bressingham Hall, just on the Norfolk side of the River Waveney.

Black Dyke.—The Heronry at Black Dyke near Feltwell was commenced in the year 1882, and for several years only contained 3 nests. In spite, however, of many of the nesting trees being blown down in the gale of March 1895, it has greatly increased in size, and in 1924 there were between 60 and 70 occupied nests. In the year 1916 a pair of Cormorants nested in one of the old nests in this Heronry, and reared two broods. (H. Upcher.)

Buckenham.—About the year 1914 a pair of Herons nested for the first time in a tree close to Buckenham Broad, but were robbed, the nest being only 12 feet from the ground. The following year they built in the wood near Buckenham Station, where in 1920 there were 3 nests, and in 1921, 4 nests. In 1924 there were 5 or 6 occupied nests. (Mrs. Hurry Palmer.)

Catfield.—This Heronry, in the grounds of Catfield Park, started, I believe, about the year 1906 (M. Bird). In 1911 there were 4 nests. In 1918, 12 nests; in 1921, 18; and in 1924, only about 8.

Didlington.—I have included this, one of the oldest and certainly the most famous of Norfolk Heronries, in my list, although I regret to learn that in 1924, for the first time for well over a hundred years, there were no occupied nests. The Didlington Heronry appears to have been first established about the year 1808, and soon became famous on account of the sport which its occupants afforded to the hawking parties of Col. Wilson, afterwards Lord Berners, the then owner of Didlington, who, during the early part of the 19th century, was the principal supporter of falconry, not only in Norfolk, but in England. The Herons originally nested at High Ash plantation, but about the year 1858, owing to the brushwood being cut down, they moved about half a mile away to a large Scotch Fir Wood, where in 1868, Henry Stevenson recorded that there were between 60 and 70 nests (Birds of Norfolk, vol. 2. p. 132). Latterly, for some reason, the number of nesting pairs have decreased rapidly. For the past 10 years there have been, I believe, no more than 5 or 6 nests, and in 1924, as I have already stated, the Heronry was entirely deserted.

Earlham.—This is another Heronry of very old standing, the history of which, as related by J. H. Gurney (*Sen.*) to Henry Stevenson (Birds of Norfolk, vol. 11. p. 134), appears to be shortly as follows :—

About the year 1810, a wood was cut down near Acle in which was an old established Heronry, which is mentioned in Hunt's "British Ornithology," and the birds from this all went to Keswick, where they formed a new Heronry. This, however, they deserted in 1830 and moved on to Taverham. Being persecuted by the keepers at Taverham, the majority again moved on across the river to Earlham Fir Wood. Here they came into collision with the Rooks, and they again shifted their quarters to the "New Plantation" by Earlham Pond, where a pair or two still nest to-day. Here their numbers appear at first to have increased rapidly, until in some seasons there were between 80 and 100 nests. A gale on February 28th,

1860, blew down most of the nesting trees, and many of the birds moved back to Taverham and Costessey, and the numbers at Earlham were reduced in 1866 to 2 or 3 pairs. In 1868, however, there were again as many as 16 or 17 nests. During the past 20 years, the Earlham Heronry appears to have held its own, and no more. In 1903 there were 7 nests, but none in 1907. In 1911 there were 2. In 1918 and 1919, 7. In 1921, 4, and in 1924 there were 5 nests, but only one appeared to be occupied. Whilst this year, 1925, there are again 4 or 5 occupied nests.

Fishley.—I am informed by Dr. S. H. Long, that a single pair of Herons nested in Fishley Carr, near Acle, in the years 1923 and 1924.

Gunton.—The Heronry at Gunton Park was described by Southwell, in 1879 as a "flourishing colony." (Footnote to Lubbock's "Fauna of Norfolk," p. 85). In 1882 there were 38 nests (J. H. Gurney), in 1911, 19 (M. Bird), and in 1924 about 30. Originally the Heronry was on the island in the lake, but these trees having been blown down, the nests for the past few seasons have been built in trees beside the lake.

Holkham.—According to Southwell (footnote to Lubbock's "Fauna of Norfolk," p. 85), the Holkham Heronry was first established about the year 1870, and had increased in 1879 to a total of 33 nests. J. H. Gurney states (Zool.; 1890, p. 333) that in 1872 there were 4 nests. In 1889 there were 14 nests, in 1890 only 7, and in 1921, 26 (Gurney). Up to the year 1910, Mr. A. E. Tower tells me, the Herons nested both in Church Wood and Obelisk Wood, but the operation of cleaning out the Lake during that year frightened the birds away from Church Wood, and they have since only nested in Obelisk Wood. Here, in 1924, there were well over 20 occupied nests, most of which were built in giant Ilex trees, this being, I imagine, the only instance in England of Herons nesting in this species of tree.

Horning.—It is probable that a few isolated pairs of Herons nest from time to time in Alder Carrs in the Broads District. Since 1922, and possibly before this, there have been two occupied nests in Alder trees nearly opposite Horning Hall, on the south side of the river.

I can find no record of Herons having nested at Horning in the past, but that they did so at one time may be inferred from the fact that J. H. Gurney recorded ("Zoologist," 1904, p. 218) that there were "none at Horning" in 1903.

HOVETON.—A new Heronry was commenced in the year 1920 in a clump of Alder trees on the south side of Hoveton Big Broad. In 1921 there were 7 occupied nests, and in 1924 about 12.

ISLINGTON.—The exact age of the Heronry in the Park of Islington Hall is, I believe, unknown, though I understand from Mr. N. Tracy, that it has been in existence as long as the oldest local inhabitants can remember. For the past 14 years, the number of nests have averaged between 60 and 100, and in the year 1924, there were 80.

KIMBERLEY.—This is another old Heronry. Stevenson records (Birds of Norfolk, vol. II, p. 135), that in 1868 there were only 2 nests, but that he was informed by the head-keeper that the Heronry had then been in existence for 20 years, which takes us back to 1848. In 1911 there were 30 nests, and in 1924 about 15. The nests are built in trees on the island in Kimberley Lake.

MELTON.—How long the Heronry at Melton Hall has been established does not appear to be known, but I learn from Lord Hastings that it has been occupied as long ago as the late Lord Hastings, his father, could remember. For the past few years there have usually been about 15 nests in Scotch Fir trees, beside the Lake, and 5 nests in an Alder tree on the island. In the year 1914, a pair of Cormorants nested in a disused nest in the Alder tree on the island, and reared 4 young.

MAUTBY.—The first record which I can find of this Heronry, which is in the grounds of Mautby Hall, is in the year 1882, when J. H. Gurney recorded it as "a new one," but containing nearly 100 nests. ("Zoologist," 1882, p. 294). In 1887 this number was reduced to about 12, and there were none in 1903 (Gurney). In 1923 there was only 1 occupied nest, and in 1924, 2 (W. Watson).

NARFORD.—The Heronry in Decoy Wood, in the grounds of Narford Hall, is another the age of which does not appear to be known. In 1911 there were 6 nests (M. Bird), in 1922 between 10 and 15 (W. G. Clarke), and in 1924, 11 (F. A. Attwood).

Reedham.—Although Sir Thomas Browne wrote of Spoonbills having "formerly built in the Heronry at Claxton and Reedham," no Herons nested in this locality at the time (1868 *circa*) when Stevenson wrote the 2nd volume of the "Birds of Norfolk," and the present Reedham Heronry was first recorded by the late W. H. Hudson in 1894, in which year it contained 30 nests ("Zoologist," 1895 p. 98). In 1901, there were between 80 and 90 nests, and about that number appears to have been maintained each year up to the present time, Reedham and Islington being now the two largest Heronries in the county.

Ranworth.—This Heronry, which is situated in Alder trees beside Ranworth Broad, commenced in the year 1911 with 1 nest (M. Bird). In 1922 there were 4 occupied nests, and in 1924 about the same number.

Rollesby.—According to J. H. Gurney ("Zoologist," 1904, p. 218), a pair of Herons nested at Rollesby for the first time in 1903. Since that time there appear to have been 1 or 2 nests each year, but never, I believe, more. There were 2 in 1911, and there has been 1 every year for the past few years up to 1924). (Major Benn.)

Wolferton.—The Heronry at Wolferton, in the grounds of the Sandringham Estate, is certainly a very ancient one, and possibly the oldest in Norfolk. In the L'Estrange "Household accounts" mention is made of "an itm paid at Lynne, when ye went hawkying to Wolferton Wood," which at least suggests the possibility, as pointed out by Stevenson (Birds of Norfolk, vol. 11, p. 136), of a Heronry having been there even at that time.

The Wolferton Heronry was noted by Southwell as long ago as 1853 ("Naturalist," 1853, April, p. 87), whilst Stevenson records there being 20 nests there in the year 1868. During the past few years, unfortunately, the number of nesting pairs appears to have steadily decreased, and I am informed by Mr. Bland, the Head-keeper, that in 1924, there were not more than 4 or 5 occupied nests.

In conclusion it will be seen from the above list, that, not counting Didlington, which was deserted last year, but to which

it is very much to be hoped the Herons may again return, the total number of occupied Heronries in Norfolk in 1924 was 19, whilst the number of Herons breeding in the county appears to have been between 370 and 380 pairs.

V

AN INVESTIGATION OF THE FOOD OF TERNS AT BLAKENEY POINT, NORFOLK

By Walter E. Collinge, D.Sc., F.L.S., M.B.O.U.
(Keeper of the Yorkshire Museum, York.)

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2. Previous Work
3. Natural History of the Terns
4. Food and Feeding Habits of—
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   (3) The Little Tern
5. Relations to the Fisheries
6. Summary and Conclusion
7. Bibliography

1. Introduction

Very few detailed investigations have been made in this country on the nature of the food and the feeding habits of our commoner sea-birds, in consequence of which much of the present-day knowledge is largely founded upon hearsay, imperfect observations, and incomplete study.

Rightly or wrongly, it has been assumed that the bulk of the food of sea-birds consists of fish, but when careful and detailed investigations are made, and the stomach contents properly analysed such is not found to be the case, except in such species as the Cormorant, Shag, Gannet, Goosander, and Merganzer. We have shown (3) that of the total bulk of food eaten by the Black-headed Gull, only 11.5 per cent. consists of food fishes, and 22 per cent. is injurious insects.

To obtain these figures more than five hundred specimens were examined, obtained from various localities, and during each month of the year. It was further pointed out that the commoner species of sea-birds may be divided into three classes, viz :—

i. Purely fish-feeders, e.g., Cormorant, Shag, etc.
ii. Largely fish-feeders, but most of the fish are not utilised by man as food, e.g., Common and Sandwich Terns.
iii. Fish-feeders to less than 20 per cent. of the total bulk of their food, e.g., the Gulls.

We have elsewhere pointed out : " It is very easy to condemn a species because at some particular season of the year or in some district a certain number have been found to be feeding upon food fishes ; but, as has been frequently pointed out, such partial records do not give a true estimate of the food as a whole. We contend that it is unfair to judge any species of wild bird upon a local or partial record."

In January, 1925, we were invited by Professor F. W. Oliver, F.R.S., to undertake an investigation on the food and feeding habits of the Terns at Blakeney Point, Norfolk, a reservation held under the National Trust, in consequence of numerous complaints which had been made by local fishermen, to the effect that the Terns were destroying the inshore industry in flat fish.

2. Previous Work

In 1919 (9) the Scottish Freshwater Fisheries Committee issued a general condemnation of sea-birds, including the Common Tern. The Committee states : " after further investigation " they are satisfied that these birds " are all without any doubt most destructive to young fish and the larvæ and flies on which they feed." It is important, however, to remember that as yet we have no published information as to the nature of these investigations, or by whom and where they were carried out.

Mr. H. W. Robinson (8) writes : " The chief food of the Common Tern consists of young herrings, with a fair number of young whiting, and also a few young codling, lumpsuckers, and long rough dabs ; and although the colonies visited were

bounded by rivers famous for their salmonidæ, no trace of the young of any freshwater fish was found, either in the birds or on the ground.

The food of the larger Sandwich Tern is almost entirely young whiting. He concludes, after having " handled over two thousand young ones, the majority of which regurgitated the contents of their crops," and that they feed " on the countless millions of small-fry, whose incredible numbers are beyond belief."

In 1920 (4) we published the results of an examination of numerous stomachs of the Common Tern obtained on the East and West Coasts of Scotland, and practically during each month of the year. This investigation showed that the total bulk of food was of an animal nature, and that 65 per cent. of this consisted of fish of various kinds. Sand eels formed 35 per cent., whiting 6 per cent., herring 6.5 per cent., haddock 5.5 per cent., lumpsuckers 4 per cent., and 2 per cent. each of gobies, gurnard, and gunnel, and 2 per cent. unidentifiable. In none of the stomachs were there any traces of freshwater fishes or of flat fishes. Of the remainder of the food, crustacea and marine worms were present to the extent of 18.5 per cent., mollusca 12 per cent., and of miscellaneous animal matter 4.5 per cent.

Still later (6) we have computed the percentages of the different kinds of food taken by 109 specimens of the Common Tern from January to December, and the results are as follows :—

Of the total stomach contents, 53.70 per cent. consists of fish, .01 per cent. of fish ova, 32.41 per cent. of crustacea and annelids, 13.84 per cent. of marine molluscs, and .04 per cent. of miscellaneous animal matter.

The percentage of the actual species being as follows :— Whiting 6.00 per cent., herring 6.50, haddock 5.50, sand eels 26.50, gurnard 2.00, gunnel 1.50, gobies 1.55, lumpsucker 2.00, unidentified remains 2.15.

Mr. Campbell-Taylor (1) states that after examining the stomach contents on many occasions, he is " fully convinced that their diet is almost, if not exclusively, marine." . . . . " The bulk of their food consisting of small marine fish, with a considerable admixture of crustaceans, mollusca, and some marine worms."

3. Natural History of the Tern

A few notes on the natural history of the three species of Terns here dealt with may be of interest. Our knowledge as yet is very fragmentary, in spite of the valuable observations of Messrs. H. W. Robinson, W. Bickerton, Kirkman, F. C. R. Jourdain, E. B. Dunlop, P. R. Lowe, Miss Haviland, and others.

It is generally accepted that the Sandwich Tern arrives in this country earlier than the Common Tern or the Little Tern. The first-mentioned arriving in March, the Little Tern about the middle of April, and the Common Tern during the latter part of April ; and all are supposed to leave us about the end of September or early in October.

This may be true in certain localities, but it does not hold good for the country generally, as the following records will show. On the 9th December, 1918, I received two male specimens of the Common Tern from near Aberdeen ; on 24th January, 1919, one female from near St. Andrews, Co. Fife, and a male from the same locality on 19th December. During 1920, a male specimen was received on 12th January, and two females on the 22nd, all from near St. Andrews. On the 24th February, two males from Aberdeen, and two females on the 14th from near St. Andrews, came to hand. During October of the same year eight specimens were received from different parts of the East Coast of Scotland, four in November, and five in December, or a total of twenty-eight birds between the months of October and February. With the exception of one of the October birds, all were adults, sixteen males and twelve females.

From the above remarks it will be seen that this bird does occasionally remain longer with us, and also arrives here earlier than April. Moreover, it seems clear that stragglers visit our coast between October and April, either as occasional visitors or as birds of passage. (5).

The Common Tern is the only one of the three here dealt with that makes any pretence at a nest. The Sandwich Tern occasionally gathers together a few wisps of grass or bits of dried sea-weed, while the Little Tern lays its eggs in a simple cup-shaped depression in the sand or pebbles.

Two eggs are the normal for the Sandwich Tern in our experience, but three are occasionally found.

4. The Present Investigation

Food and Feeding Habits.—For the purpose of this investigation, fifty-five specimens have been available, viz.: forty-one Common Terns, nine Sandwich Terns, and five Little Terns.

The Common Tern.—*Sterna hirundo* Linn.—Forty-eight specimens were received. The stomachs of seven were empty, thus leaving forty-one for examination. Of these seven were received in May, nine in June, thirteen in July, eight in August, and four in September.

Twenty-three were males and eighteen females.

Food Habits.—The whole of the stomach contents consisted of animal food, of which 25.46 per cent. was remains of food fishes. In reporting on the different species of fish found in the Terns' stomachs we have separated the sand-eel from the others in the annexed tabular statements because the sand-eel forms in so many cases one of the most important elements of the food. The "food fishes" which are lumped together in the tables include whiting, haddock, herring, and whitebait. It is not intended to imply that sand-eels are not used for food—14.64 per cent. remains of sand eels, 25.59 per cent. remains of crustacea, echinoderms, and annelids, 10.20 per cent. remains of marine molluscs, 2.22 per cent. of injurious insects, 12.44 per cent. of neutral insects, and 5.23 per cent. of miscellaneous or unidentifiable animal matter.

Of the food fishes, whiting, haddock, herring, and whitebait were identifiable. No traces of freshwater or flat fishes were met with. The other fishes consisted of sand-eels. The injurious insects were cockchafers, and the neutral ones remains of some small dipterous fly and the ant, *Lasius niger* Linn.

Of the forty-seven specimens, seventeen contained remains of food fishes, ten remains of sand-eels, and sixteen no fish remains whatever.

Table Showing the Monthly Percentages of the Chief Food Items of the Adult Common Tern.

Food Items.	May.	June.	July.	August.	Sept.	Avges.
Food Fishes ...	27.14	2.28	26.15	71.88	—	25.48
Sand-eels ...	21.43	2.78	25.00	18.75	6.25	14.84
Crustacea ... (Crab & Shrimp Family)	14.30	—	13.08	—	43.75	14.22
Annelida ... (Marine Worms)	—	52.22	24.56	—	—	15.36
Echinoderms ... (Starfish, etc.)	—	—	.05	—	—	.01
Marine Mollusca (Shell-fish)	25.70	22.22	3.08	—	—	10.20
Injurious Insects	—	11.11	—	—	—	2.22
Neutral Insects	11.43	—	.77	—	50.00	12.44
Miscellaneous	—	9.45	7.31	9.37	—	5.23
Totals ...	110.00	100.00	100.00	100.00	100.00	100.00

THE SANDWICH TERN.—*Sterna sandvicensis* Latham.—Nine specimens were received. Of these, six were received in May, and one each in June, July, and August. Seven were males and two females.

FOOD HABITS.—The whole of the stomach contents consisted of animal food, of which 31.46 per cent. was remains of food fishes, 34.79 per cent. remains of sand-eels, 32.50 per cent. remains of annelids, and 1.25 per cent. remains of marine molluscs.

Of the nine specimens, four contained remains of food fishes, five remains of sand-eels, and one no fish remains whatever.

Table Showing the Monthly Percentages of the Chief Food Items of the Adult Sandwich Tern.

Food Items.	May.	June.	July.	August.	Sept.	Avges.
Food Fishes ...	45.85	80.00	—	—	—	31.46
Sand-eels ...	49.17	—	—	90.00	—	34.79
Crustacea ... (Crab & Shrimp Family)	—	—	—	—	—	—
Annelida ... (Marine Worms)	—	20.00	100.00	10.00	—	32.50
Echinoderms (Starfish, etc.)	—	—	—	—	—	—
Marine Mollusca (Shell-fish)	5.00	—	—	—	—	1.25
Injurious Insects	—	—	—	—	—	—
Neutral Insects	—	—	—	—	—	—
Miscellaneous...	—	—	—	—	—	—
Totals ...	100.00	100.00	100.00	100.00	—	100.00

The Little Tern.—*Sterna albifrons* Palls. Food Habits.—Only six specimens have been available, of which one stomach was empty. Of the remainder four were received in May and one in September. All were males, excepting the one received in September.

Food of Adults.—The whole of the stomach contents consisted of animal food, of which 1.87 per cent. was remains of fish (probably whiting), 96.88 per cent. consisted of remains of crustacea (Mysids, etc.) and annelids, and 1.25 per cent. of marine mollusca.

It is scarcely possible to draw any satisfactory conclusions from so small a number of specimens, and obtained practically in a single month of the year.

Only one specimen contained remains of food fishes, viz., 3.75 per cent. of whiting remains.

Table Showing the Monthly Percentages of the Chief Food Items of the Adult Little Tern.

Food Items.	May.	September.	Averages.
Food Fishes ...	3.75	—	1.87
Sand-eels ...	—	—	—
Crustacea ...	93.75	—	46.88
Annelids ...	—	100.00	50.00
Echinoderms ...	—	—	—
Marine Mollusca	2.50	—	1.25
Injurious Insects	—	—	—
Neutral Insects	—	—	—
Miscellaneous ...	—	—	—
Totals ...	100.00	100.00	100.00

5. Relations to the Fisheries

Under Section II, we have stated the results obtained by other investigators and the results we ourselves have obtained from two independent investigations. It seems to us that the mean of these three investigations will most accurately show the relationship of the Common Tern to the Fisheries; we therefore summarise them as shown in the following table :—

Table Showing the Averages Percentages of the Chief Food Items of the Common Tern as the Results of Three Separate Investigations.

Food Items.	I. East & West Coasts of Scotland.	II. Great Britain.	III. Blakeney Point.	Averages.
Food Fishes	18.00	18.01	25.48	20.50
Sand-eels	47.00	35.70	14.84	32.51
Crustacea and Annelida (Crabs, Shrimps, and Worms)	18.50	32.41	29.59	26.83
Marine Mollusca ... (Shellfish)	12.00	13.84	10.20	12.01
Injurious Insects ...	—	—	2.22	.74
Neutral Insects ...	—	—	12.44	4.15
Miscellaneous	4.50	.04	5.23	3.26
Totals	100.00	100.00	100.00	100.00

6. Summary and Conclusion

As a result of this investigation it is shown that the food of the Common Tern in the vicinity of Blakeney Point consists of 40.32 per cent. of fish, of which 25.48 per cent. is food fishes and 14.84 per cent. sand-eels. The species identified were whiting, haddock, herring and whitebait, species which occur in such prodigious numbers that no action of either mankind or birds can affect in the slightest.

The remainder of the food is largely of a neutral nature, the beneficial items being 2.22 per cent. of injurious insects (Cockchafers) and a fraction of echinoderms.

If we take the average of the three species investigated, which are collectively charged with doing so much harm, we find that the percentage of food fishes eaten is only 19.60 per cent., non-food fishes (sand-eels) 16.54 per cent., crustacea, annelida, etc., 52.99 per cent., marine molluscs, 4.23 per cent., injurious insects, 74 per cent., neutral insects, 4.15 per cent., and miscellaneous matter 1.74 per cent.

As a result of previous investigations on the food of the Common Tern we have shown that the percentage of food fishes eaten averages about 18 per cent., and the average for all the three investigations only totals 20.50 per cent.

It is significant that in not a single stomach of the Blakeney Point birds was there any trace of flat fish.

Putting aside for the moment the opinions of Huxley, M'Intosh, and other investigators, which are strongly adverse to any theory of the impoverishment of the sea, it seems clear that any shortage of inshore fishes at Blakeney Point can hardly be accounted for by the presence and preservation of Terns.

If the absence of inshore fish were due to the Terns, then we should also have a scarcity of sand-eels, various crustacea, annelids, and marine molluscs, whose percentage far surpasses that of the food fishes eaten, but there are no such signs.

We are, therefore, thoroughly convinced that the recent scarcity of flat fish at Blakeney Point is due to some other factor, and feel certain that if the whole of the Tern population of Blakeney Point were to migrate elsewhere, the result would not be marked by any increase in the fisheries.

To those acquainted with fishery investigations, these migrations or diminutions are nothing new, and their cause or causes still remain unsolved, but of one thing we are quite certain, viz., that the feeding habits of Terns or any other sea-birds bears no relation to them.

It is a pleasure here to offer my thanks to Professor F. W. Oliver, F.R.S., for answering many inquiries, to Dr. C. J. Gahan of the British Museum (Natural History) for the identification of insect remains, and to Messrs. R. J. Pinchen and William Bishop for the care they have taken in obtaining, labelling, and forwarding the specimens necessary for this investigation.

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THE SUB-COMMITTEE'S COVERING LETTER

THE Report on the Feeding of Terns at Blakeney Point, prepared by Dr. W. E. Collinge, originated in the following way :—

In former times, among the various fishing industries of Blakeney Harbour, was the catching of flat fish—plaice, flounders (" butts ") and dabs. To-day this industry has decayed, and flat fish are procurable only in small numbers. More or less coincident with this decline has been the growth of a well populated Terns' breeding ground on Blakeney Point, which, though in existence as far back as living memory serves, has been protected only since the year 1900 ; at first by a local society, later by the National Trust.

Terns, as is well known, take their food from the sea, mainly in the form of fish—an activity which has always been viewed askance by the fishing community. The Blakeney Point Ternery though at no time a very large one, numbers perhaps two thousand birds in a prosperous season. It is probably roughly correct to say that its average population in the five years, 1920-24, is about double that of the five years, 1900-1904.

During the last few years, in addition to Common and Little Terns, the colony has been reinforced by the addition of Arctic, Roseate, and Sandwich Terns. Whilst the numbers of Arctic and Roseates are quite negligible, Sandwich Terns have come to the Point in increasing numbers, reaching perhaps four

hundred in the season of 1924. These accessions have undoubtedly increased the fame of the Tern Colony, which attracts many ornithologists and others interested in bird life to visit the locality during the breeding season. It has already formed the basis of several detailed statistical and other studies, and as it is well cared for and facilities are available, it is probable that it will continue to be used.

The relative prosperity of the Tern Colony on the one hand, and the scarcity of flat fish in the harbour on the other, were interpreted by the local fishermen as standing in the relation of cause and effect, that is to say, the Terns were blamed for the shrinkage of flat fishing. The grievance came to a head last winter, and a largely attended meeting of fishermen was held at Blakeney, on December 15th, 1924, to consider the matter. At this meeting a resolution was adopted to the effect that the protection of Terns on Blakeney Point had resulted in material loss to the fishermen from the numbers of immature fish taken by the birds. As the matter could not be left in this unsatisfactory state, negotiations with the fishermen were opened by the National Trust through the good offices of Mr. Sam Peel, of Wells, who had presided over the meeting of December 15th. The basis of these negotiations was that an investigation should be made during the breeding season of 1925 to get evidence as to the precise nature of the food of the Terns. This offer was accepted by the fishermen with the result that delegates were appointed to meet and discuss the matter with representatives of the National Trust and others at a conference held in Norwich, on February 7th, 1925.

At this conference the general scope of the enquiry was outlined and agreed to by all present. For convenience, we give here in full the report of this conference, as it appeared in the *Eastern Daily Press* of February 9th, 1925.

TERNS AT BLAKENEY POINT

Agreement Between Fishermen and National Trust

Under the chairmanship of Mr. J. A. Christie, M.P., a conference was held at 31, Surrey Street, Norwich, on Saturday, between representatives of the Blakeney fishermen and of the National Trust, to consider what steps should be taken to settle the relationship, if any, between the Tern Colony on Blakeney Point and the shortage of flat fish in Blakeney Harbour. Messrs. W. Bishop, W. Long, and W. Starling, attended as delegates sent by the fishermen, the National Trust being represented by Professor F. W. Oliver, F.R.S., and the Norfolk Wild Birds Protec-

tion Committee by Dr. Sydney H. Long. Mr. Sam Peel introduced the representatives of the fishermen. Mr. J. O. Borley, Deputy Director of Fishery Investigation of the Ministry of Agriculture and Fisheries, attended the conference as did Mr. A. H. Patterson, of Yarmouth.

After a full discussion of the subject, which included a statement by Mr. Borley of the complexity and difficulties inherent to any such investigation, the conference resolved upon a line of action which is outlined in the following resolutions, which were unanimously agreed to :—

(1) That in the opinion of this conference it is desirable that an investigation be made throughout the breeding season of 1925 into the nature of the food taken by the Terns, from the time of their arrival in the spring until their departure in the autumn.

(2) That with a view to arranging the details necessitated by this resolution a sub-committee consisting of Professor F. W. Oliver, as representing the National Trust, and Mr. William Bishop, as representing the fishermen, be appointed with power to co-opt a third member who would act as chairman of the Sub-Committee. It will also be the duty of this Sub-Committee to embody the data arising from the investigation, together with other relevant matter, in a draft report to be presented to a further meeting of the conference to be held before the end of the current year.

As this investigation will necessarily involve the shooting of a limited number of Terns at regular intervals through the coming breeding season for the purpose of having their stomach contents analysed by an expert, it was understood that the National Trust would take immediate steps to inform the Norfolk County Council of the wishes of the conference, so that the Council might release an accredited officer of the Trust for the period of this investigation from the operation of the Wild Birds Protection Order of this body, under which all species of Terns are protected throughout the year in the County of Norfolk.

The principal work of the investigation, that of making the weekly analyses of the terns' stomachs, was delegated to Dr. W. E. Collinge, of the Yorkshire Museum, York, the main authority in this country in this field of inquiry. Without Dr. Collinge's welcome offer of assistance, the task of the Sub-Committee would have been a difficult one, and they and the Conference are much beholden to him. In consultation with Dr. Collinge, it was arranged there should be weekly sendings of Terns throughout the breeding season, according to the following scheme.

Common Tern and Sandwich Tern, two each per week ; Little Tern, one per week during the first month, and two more towards the close of the season. The number of Arctics and Roseates being negligible, no specimens were to be collected. The reason why so few Little Terns were to be taken, was because their numbers as a rule do not exceed fifty pairs, and a toll of two a week would involve a serious depletion of the Colony.

Actually under the conditions of the 1925 season, we were able to send Dr. Collinge the full number of Common Terns stipulated, viz., forty-eight. Of Little Terns six were sent, but in the case of Sandwich Tern, owing to the unexpected shortage recorded below, it was not possible to deliver more than nine specimens.

The actual shooting and sending of the birds to York was carried out by Mr. R. J. Pinchen, the National Trust Watcher, in conjunction with Mr. William Bishop, representing the fishermen. Where possible the shooting of birds was avoided on the breeding ground itself, actually one specimen only was shot on the breeding ground, the specimens being shot at various spots within or outside the Harbour, and on the main beach. Taking a line from Cley Beach outside the Marams and Hood and following the edge of the sandhills to the tip of the Far Point, about three-fifths of all the specimens were shot to seaward of that line, whilst the remaining two-fifths were from the harbour side, including the Pit, Morston and Agar Creeks, etc. As a rule Mr. Bishop attended on Tuesday, and the weekly box of specimens was posted in time to reach Dr. Collinge the following morning. Each specimen was numbered and was labelled with the time and place of shooting, and a teaspoonful of methylated spirit was poured down the gullet for the better preservation of the contents. Otherwise the specimens were not interfered with in any way. The task allotted to the collectors, as will be readily understood, was far from congenial, and the conference (and all others interested in the matter) are under a high obligation to them for resolutely persevering with it throughout what proved to be an unusually prolonged season.

The Breeding Season of 1925

The first Tern (a Sandwich) was seen at the unusually early date of April 9th—curiously enough on the occasion of our crossing the harbour to confer with Mr. Pinchen on the details of the collection. Others of this species were reported on April 18th and 23rd. The first Little Tern was noticed on April 25th, and the first Common Tern on the 28th; this was followed by many others by May 5th.

The adjacent table gives the more important dates for the earlier part of the season.

Species.	First Arrival.	First Eggs.	No. of Nests on May 27th.	First Chicks.
Sandwich Tern	8th April	19th May	5	None hatched
Common ,,	28th ,,	15th ,,	700	8th June
Little ,,	25th ,,	14th ,,	30	17th ,,

Towards the end of June very cold weather was experienced and this killed many chicks of the Common Tern, recently hatched. By the end of this month numerous clutches were laid and some of these were hatching out as late as August 3rd—a record late date for hatching on Blakeney Point in Mr. Pinchen's experience. Many of these birds remained till the end of the first week of September, by which date in most years the areawould have been deserted for several weeks.

It will be of interest to mention here the average duration of the principal phases in the development of a Tern—figures for which we are indebted to Mr. Pinchen.

Roughly, eggs hatch out twenty-one days after laying ; by the tenth—twelfth day the chicks lose their down, and in another ten days can fly, whilst about fourteen days later the young birds should have learnt how to feed themselves.

So that the normal period from the laying of the egg till the young bird can fly and feed by itself is a matter of about eight weeks.

The Shortage of Sandwich Terns

Undoubtedly the most striking fact of the 1925 breeding season has been the failure of the Sandwich Terns to nest. From small beginnings in 1920 this species had increased in numbers till in 1924 as many as two hundred nests were counted on June 5th. In 1925 there were only five nests in all ; the great majority of the Sandwich Terns are conjectured to have migrated to the Scolt Head area, where an enormous increase in numbers was recorded this year. The fact that birds were being shot, will be adduced by some as the cause of this desertion—a view we do not think should be adopted

without consideration. Prior to 1920, and before they had settled on Blakeney Point, Sandwich Terns were already breeding at Salthouse. In a sense the Blakeney settlement was an extension or offshoot of the Salthouse Colony. Now in 1925 the Sandwich Terns abandoned Salthouse as completely as Blakeney Point, though there had been no shooting whatever at the former station.

Though we are not in a position to account for this sudden migration there are certain circumstances connected with the Tern Colony that may have a bearing on the subject.

1. Egg-pecking.—During the latter part of June, 1923, the Sandwich Tern Colony both at Salthouse and Blakeney Point suffered from mysterious egg-pecking. Mr. T. A. Coward, the well-known ornithologist, was staying at Blakeney Point at the time, and was able to study the matter in detail. The following is quoted from a recent article by Mr. Coward in the "National Review" of May, 1925. "At Blakeney and Salthouse in 1923, the Sandwich Tern Colony suffered in a mysterious way; numbers of eggs which were laid late in the season were destroyed by fracture, which in all that I examined, had been caused by a single stab or peck from the beak of a bird. These eggs were not sucked. The contents flowed or oozed out, and all that I saw so damaged were fresh. Incubated eggs were not attacked, and within a day or two of the cessation of this trouble, young birds were emerging. In spite of careful watching I failed to detect the culprits, and though at first I suspected that gulls were responsible, and had been driven away by the Terns before they accomplished their purpose, concluded that the damage was done either by the Common Terns, or by the Sandwich Terns themselves. Marauding gulls could not have discriminated between fresh and incubated eggs. Theorising on the psychology of birds is dangerous, and yet the behaviour of gregarious or colonial animals is regulated by communal laws for the advantage of the race rather than the individual. If, as I suspect, 'egg pecking' was due to the Terns, there is a possible explanation, supported by observations at Ravenglass. The Common Terns, resenting the increase of their larger congeners and rivals on the territory that they claimed as their own, pecked those eggs which were unguarded by incubating Sandwich Terns."

If the theory of Mr. Coward is well founded, the simultaneous departure of Sandwich Terns from Salthouse and Blakeney Point would be attributable to animosity against them displayed by Common Terns in both localities.

2. There is another circumstance that may have determined the desertion of Salthouse by the Sandwich Terns, and this is the construction of the new cut on the Cley Channel. This was completed in June, 1924, from which time it became effective in draining off the water in the Salthouse area. Prior to this, the Cley Channel, where it runs alongside Cley Beach, had become blocked by shingle, so that the drainage of the marshes to the east was impeded. The fall of the water level at Salthouse, was a disturbing factor which may have unsettled the Sandwich Terns and led to their departure.

To make this theory apply to the Blakeney contingent we should have to assume that this, originally an offshoot of the Salthouse group, still held allegiance to the parent Colony, and decided to throw in its lot with them.

3. If the real cause of the desertion of the Blakeney Colony was the shooting, some other plausible explanation has to be found for the simultaneous departure of the Salthouse birds. This is provided by the new Cley Channel having by the beginning of the 1925 season, lowered the water level at Salthouse to such a degree as to render this station undesirable as a breeding ground for Sandwich Terns. In this case the two migrations would be independent of one another, and that they occurred together, a coincidence.

The true cause or causes will probably never be known, and certainly we are not in a position to urge one in preference to another. Coming now to Dr. Collinge's report. This speaks for itself, and there is no need for us to elaborate its points.

One conclusion certainly emerges, viz., the absence of flat fish from the stomachs of the birds examined. So that so far as this inquiry is concerned, the Terns must be exonerated from direct interference with flat fish.

Another feature of interest is the varied nature of the food taken by Terns ; this includes not only fish but, on occasion, quantities of marine worms, shell fish, crustacea, and occasionally insects.

Dr. Collinge in his report distinguished between "food fish" and "other fish." By "food fish" he means the young or regular marketable fish, naming whiting, haddock, herring, and whitebait amongst the species recognised. Under "other fish," species not usually marketed are indicted, but as in the present case these were all sand eels, we have substituted (with Dr. Collinge's sanction) "sand eels" for "other fish" in the various tables.

Whatever may be the practice elsewhere, the sand eel at Blakeney is esteemed as a food fish—if not universally, at any rate by the discriminating. It is often caught in large numbers, especially by family parties who visit the harbour at low tide for the purpose. This summer sand eels were abundant and the Terns had their share.

There is another fish occasionally taken by Terns not recorded in Dr. Collinge's return. This is the stickleback. Captain Lloyd at the Stiffkey Freshes one day in June noticed a Tern fishing. He startled it and it dropped the fish, which Captain Lloyd brought round to the Boat House. None of our specimens were shot in that particular locality or elsewhere (as at Cley) where fresh water enters the Harbour. Had they been, no doubt the occasional presence of sticklebacks would have been recorded.

In conclusion, we have only one other matter to notice. We were empowered by the Norwich Conference to co-opt a third member who would act as Chairman of the Sub-Committee. It was specially in case any difficulty should arise in connection with the drafting of this report that we think this precaution was made.

As a matter of fact, the undersigned have got on together quite harmoniously from first to last, and as nothing has arisen to make it needful to have a third opinion, we have refrained from co-opting an additional member.

WILLIAM BISHOP,

F. W. OLIVER.

October, 1925.

The expenses in connection with the Inquiry, amounting to between £40 and £50, were generously borne by those mentioned overleaf.

Mrs. Ash, T. Brash, Mrs. Burrows, J. W. Castle, J. A. Christie, M.P., Mrs. Dew, Dr. J. S. Gayner, D. Gunn, J. Rudge Harding, Mrs. Watson Kennedy, Lady Leconfield, Rev. D. L. and Mrs. Lee-Elliott, Major C. E. Lyon, A. Holte Macpherson, F. W. Oliver, Dr. E. A. Reid, The Society for the Promotion of Nature Reserves, The National Trust.

MEMORANDUM ON THE BLAKENEY FISHERIES

By. J. W. Allen

I am much interested in the friendly enquiry that is about to be held on the question of the possibility of damage being done to the fishing ground by the Terns on Blakeney Point, and am glad to offer some account of my experiences, that date back for many years past.

I was a member for many years of the original Bird Protection Society, and have studied the habits of the Terns and other sea birds over a period extending from 1879 to the present year.

For many years, going back to an early date, I fished in the Harbour every August and also at other times in the year, spending the greater part of my holidays in this way. During the last ten years I have done less fishing, and this is mainly due to the fact that the fishing has fallen off so much that it is scarcely worth while.

When I first fished Blakeney Harbour there was great abundance of fish, particularly of Flounders (" Butts "). There were also Plaice, Eels, Smelts, Bass, Mullet, and Codling in the Autumn. Fish were to be found from Cley Channel down to within a mile of the Bar. During all that period there has been, as a rule every summer, a quantity of small fry upon which the Terns feed.

There has been a steady falling off in the quantity of all kinds of fish since the early eighties, and at the present time Butts are practically the only fish to be obtained, and these are as a rule small.

I have studied during these years the reasons for the falling off in the quantity of fish. I must confess I do not understand why the supply of Eels has diminished, but there is one excellent reason for the flat fish as well as for Bass and Mullet.

For some years after I began fishing there were wide areas of mud flats extending from Cley Channel down to the Pit, and there was also a hard muddy bottom in the Narrows. These muds contain great quantities of food for fishes, such as Lug and other Worms, small Cockles and Periwinkles and certain weeds upon which particularly Mullet feed. I have seen these feeding grounds gradually covered with sand, and in some parts with marine plants. The feeding grounds have diminished enormously, and there are very few areas remaining.

I think this shrinking of the feeding grounds entirely accounts for the great falling off in the quantity of fish to be found in the Harbour. Seals have possibly played a small part, but there were Seals in the Harbour forty years ago, though perhaps they were not so numerous as they are now.

There is one other point to be considered, and it is that the Deep Sea Fishermen have of recent years found a considerable falling off of flat fish on the fishing grounds between the Dogger and the coast, and this is said to be due mainly to over-fishing.

I am told that the Blakeney fishermen think that the great falling off of the quantity of the fish in Blakeney Harbour is due to the Terns. Now I have been watching the ways of the Terns for something like forty years, and as far as I know their food is almost entirely obtained on the wing and consists of Herring-fry and other small fish which frequent the Harbour in immense quantities most summers.

Many years ago there used to be in the lower part of the Harbour, particularly in the drainage down to Simphool, a certain quantity of small Butts, Plaice, and Turbots, and it was a common sight to see quite a flock of Gulls and Sea-Mews fishing the drainage towards the lower part of the ebb. I have never seen Terns occupied in this way, and in fact, my experience points to the fact that while the Terns may be guilty of picking up small flat-fish occasionally, their regular feeding habits are to catch small round fish by diving for them.

I may, perhaps, add that I have always found my Blakeney friends among the fishermen just as appreciative of the beauty of the Tern, and just as much given to study their life habits as myself, and I hope the result of your enquiries will be to prove that this bird is not responsible for a falling off of the fish in Blakeney Harbour.

VI

A SUPPOSED WINTER NEST OF THE HARVEST MOUSE

By Sydney H. Long, M.D., F.Z.S.

On October 1st, 1925, when paying a visit to the Sutton Broad Laboratory with Mr. A. Holte Macpherson, I was shown a nest which had been found in a reed-bed on the Broad two days previously by Mrs. Rounce. Neither Mr. Macpherson nor I had ever previously seen a nest like it, so that it may not be out of place to describe it.

The nest, which is now in the Norwich Castle Museum, is about the size and shape of the closed fist, its measurements being approximately four inches long by three in width. It is entirely composed of the intertwined fine split ends of the leaves of the Reed (*Arundo Phragmites*), and the wall is about half-an-inch in thickness. There is no lining of moss or other material, nor is there any hole of entry. Each leaf of the reed is split into from six to a dozen fine ends, which are intertwined with those of the split ends of adjacent leaves. They are not bound round the stems of the reed, as in a Reed Warbler's nest, but the nest is merely suspended between the stems by the leaves which grow out round it and are worked into it.

The height of the nest above the surface of the water was about eighteen inches, and it was found on the edge of the reed-bed bordering the Lily Pool, that is, an area of the Broad about twenty yards in diameter which has been cleared of reeds, and in which water lilies have been planted. Surrounding this pool is a dense area of reeds and rushes, extending for at least one hundred yards before dry land, or rather the marsh, is reached. I carefully examined this reed-bed two weeks later for other nests, but did not find any.

Although in its situation it reminded one of a Reed Warbler's nest, yet the absence of the cup-shaped opening at the top precluded this hypothesis. In his "Bird Biographies," p. 122, Oliver Pike describes cocks' nests of the Reed Warbler and reproduces a photograph of a nest which he believed was made by

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a male Reed Warbler. This possible origin of the Sutton nest was discussed between Mr. Macpherson and myself and was discarded.

In the "Zoologist" of January, 1881, pp. 233-237, was published the translation of a paper by Professor Schlegel "On the Winter Nest of the Harvest Mouse." He says that during the forty-three years prior to 1868 he had found only two nests of this species; one in a shrub (*Hippophae rhamnoides*) on the dunes, the other in oak-scrub about a mile from the sea. Having discovered a colony in the summer of 1868, about two miles from Leyden, in a reed-bed about six paces in width, bordering a ditch about a quarter of a mile in length, he employed an observant man to visit the place and the surrounding country and to make observations every week during the whole of one year. This led to the discovery of about fifty nests in the ditch, of various isolated nests in the neighbourhood, and of a smaller colony about a mile away containing not more than twenty nests "in the brushwood." He says that several of the nests contained young, and he collected twenty nests shewing variations in structure, presumably for the Leyden Museum.

The ditch containing the fifty nests "being filled at the end became partly dry by evaporation during the hot season." It was also inhabited by a pair of Reed Warblers, a pair of Sedge Warblers, and by two pairs of Marsh Warblers. In two instances he found that the Harvest Mouse had adapted birds' nests to its requirements by covering them with a cap of grass—one a Reed Warbler's, and the other belonged to the Common Whitethroat and still contained the broken eggs of the bird. "After the breeding season the reeds of the ditch were cut down, with the exception of a small patch in the middle of the ditch and beyond the reach of the mowers. We then saw to our great astonishment that our little mice established between these reeds nests of a very different character from those destined to receive their progeniture."

In the "Zoologist" for 1895, Vol. XIX, p. 418, Mr. J. E. Harting, giving Schlegel's description of these nests, says, "during the breeding season these were of the usual globular form, of the average size of a man's fist, and showing near the top a small circular opening for the entrance of the little animal.

But the winter nests were composed of various mosses, and were attached to and between several stems of reeds, exactly like the nests of the Reed Warbler, but more fusiform, of from six inches to a foot in height and from three to four inches in diameter. They showed no inlet, and were placed at the height of a foot over the water's level."

Schlegel does not state that he found harvest mice in these winter nests, though it is clear that he must have seen one enter, for he says :—" The animal when trying to make use of this refuge removed that part of the upper covering of the nest which is less densely interwoven and is soon entirely concealed between the moss. This part of the nest serves at the same time as a storehouse for some winter provisions, as was proved by remnants of coleopterous and a few other insects."

I think it is probable that the nest now described, and of which an accurate drawing from the pen of Miss G. A. Gay is here reproduced, is a " winter " nest of the Harvest Mouse (*Micromys minutus*.) It seems strange that this little animal should select such an exposed position as a reed-bed for the construction of its winter quarters, wherein it is difficult to believe that it could survive severe frost and storms. On the other hand, it may be that these " winter" nests are merely built for autumnal retreat. Further data on the habits of the Harvest Mouse are obviously required before this point can be settled.

VII

WILD BIRD PROTECTION IN NORFOLK IN 1925

Report of the Committee

In a county like Norfolk, which contains two of the most important Bird Sanctuaries in the British Isles, the protection of its birds, especially during the breeding season, is becoming a matter of national importance ; and the responsibility of those who have taken this matter in hand is an increasing one. On any large protected area questions, often involving matters of policy, are frequently cropping up and a decision has to be

Photo] [*E. L. Turner*

THE WATCHER'S HUT ON SCOLT HEAD ISLAND, LOOKING SOUTH

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made. At present it would be futile to attempt to get any unanimity of opinion from ornithologists on many points that arise in connexion with bird preservation, and time alone will prove whether or not the methods adopted in Norfolk are going to be successful.

The Committee is fully alive to its responsibilities, and is encouraged by the extended interest which is being created in its work. But efficiently to carry out its aims it *must* receive further financial support, and it would urge upon all those who are already good enough to subscribe to the Norfolk Wild Bird Protection Fund, to secure a new subscriber to the Fund during the year 1926.

The north coast line of Norfolk would always seem to have been attractive to terns for breeding purposes, and since Blakeney Point and Scolt Head Island have become protected areas, their numbers have increased very largely. But watchers have to be paid, and on a virgin island like Scolt Head, there is much to be done in the way of protecting the dunes, judicious planting, etc., etc., all of which costs money.

Breydon Water

For many years a watcher has been supplied for this Estuary during the summer months to prevent the shooting of any rare birds, such as Spoonbills, which may, and do, visit the Estuary during this period of the year. During the past season the Watcher, W. Jary, was on duty in the Society's houseboat from the beginning of April to the end of August.

Horsey

The small colony of Little Terns that nest at Horsey have many difficulties to contend with, and this year there were about a dozen nests on this part of the coast line. It is practically impossible to give them protection, and the Committee has come to the conclusion that they must just take their chance.

A certain number of nests will always escape observation ; the remainder will either be trampled on or pillaged, if not swept away by an unexpected high tide.

Salthouse and Cley

Whatever benefits may accrue to the landowners from the making of the New Cut in the Cley channel for the more efficient drainage of the Cley marshes and Salthouse Broad there can be no doubt of its effect upon the latter, as a nesting-ground for terns. We visited the Broad on May 10th, only to find the islands on which the birds nested in such numbers last year, now continuous with the mainland, so that we were able to walk all over the area, as on dry ground. Messrs. Donald Gunn and J. W. Castle, who had been daily visiting the Broad during the previous two weeks, reported that from 30—40 Sandwich Terns had come in and had remained about ten days, but had now departed. It is reasonable to conjecture that the large increase in the Sandwich Tern colony on Scolt Head this year may be in part attributed to the migration of these Salthouse birds to the island sanctuary.

From observations at Salthouse at different times during the summer, it is evident that, with the exception of a few pairs of Common Terns that still cling to the area for nesting purposes (there were from 50—100 nests this year) this once thickly populated ternery has now become almost deserted. A few pairs of Ringed Plover and Little Terns still nest on the shingle ridge on the N. boundary, whilst about fifty pairs of Blackheaded Gulls nested on the Broad.

Blakeney Point

From the diary of the Watcher, Mr. R. J. Pinchen, and from observations made at different visits to this well-known breeding area on the north Norfolk coast, we are able to record the principal events of interest in connexion with the breeding birds during the season of 1925.

Ringed Plover.—The first nest, with eggs, was found on April 11th. This confiding species nests all over the Point, and doubtless several clutches are laid by the same bird. As late as August 22nd, Pinchen found some young, just hatched out.

Redshank.—Several pairs nest on the area. An unexpected nest was found this year in one of the newly-formed dunes on the Far Point, in the middle of the ternery; these eggs hatched out on June 12th.

Oyster-Catcher.—In all, six nests were found on the Point and all these hatched off. For several years past it has been noted that two females lay to the same nest, and this year this nest contained seven eggs and was situated within a few yards of its position last year. Pinchen moved one of these eggs to another nest, but the remaining six did not hatch out.

Sandwich Tern.—It will be remembered that last season 143 nests of this handsome tern were counted on the Point ; during 1925 there were only eight nests and no eggs hatched off. The birds came as usual ; in fact, the first tern to arrive was a Sandwich—on April 8th. Towards the end of April, and especialy during the second week in May, there was a large influx ; but, for some inexplicable reason, most of the birds gradually disappeared, and it is reasonable to infer that they migrated to Scolt Head.

It may be that the weekly shooting of terns for the Food Inquiry unsettled the birds and made them seek quieter nesting quarters ; on the other hand, one knows how capricious is this species, and that next season they are quite likely to return.

Common Tern.—Not until April 28th—about ten days later than usual—was the first Common Tern reported from Blakeney Point this season, and on May 15th, the first egg was found. By the end of the month, Pinchen estimated that there were about 700 nests. By the second week in June many young were hatching out. On June 24th, very cold strong northerly winds set in and lasted till the end of the month, and during this week young terns were found dying all over the nesting ground. However, with the return of warm weather in July, a large number of second clutches was laid, and by the end of the month Pinchen reported that " lots of Common Terns were hatching out." Indeed, up to the middle of August young birds were still being hatched out, and there then remained quite a number of nests containing eggs.

Roseate Tern.—On July 1st a pair of Roseate Terns were identified, and by the 10th Mr. Pinchen reports that one of these birds was found sitting on two eggs, which hatched out on July 24th. Although a second pair of Roseates were frequently heard and seen in the colony, their nest was not discovered.

Little Tern.—First seen on April 25th, the first nest with eggs being found on May 14th.

Black-Headed Gull.—For many years this species has nested on the saltings between Morston and Wells, and of late there has been a small colony (50—100 pairs) nesting on Salthouse Broad, but not until this year has a nest ever been found on Blakeney Point. On June 15th, the Watcher found a nest containing two eggs in Suœda bushes up the Beachway, and three days later a second nest was found. There are plenty of examples, notably at Ravenglass, where a ternery has been ruined by an uncontrolled invasion of Black-headed Gulls ; and although there is often a difference of opinion amongst ornithologists as to when man should exercise a discriminating control in a bird sanctuary, yet there can be no two opinions about the necessity for excluding the Black-headed Gull from any such sanctuary which is intended primarily as a breeding area for Terns.

Scolt Head Island

Like Blakeney Point, this incomparable 1,200 acres of dunes, shingle and saltings is held by the National Trust as a Nature Reserve for all time. The Norfolk Wild Bird Protection Committee has undertaken the protection of the Birds on the island during the nesting season, and has been fortunate in securing the services of Miss E. L. Turner F.Z.S., F.L.S., as its Watcher during the past two years. It is highly satisfactory to be able to report that, under protection, there has been an enormous increase in the bird population of the island, and we know of no ternery in the British Isles which is more flourishing than that at Scolt Head. On May 31st we made a census of the nests, and counted 653 nests of the Sandwich Tern, and estimated that there were from two hundred—three hundred nests of the Common Tern. The birds were still laying, so that it is no exaggeration to say that there were over one thousand terns' nests on the island this summer. It is interesting to compare this figure with the number of nests which the writer and Professor Oliver found on June 2nd, 1922—the year before the island was purchased by the Norfolk and Norwich Naturalists' Society. In the writer's diary of that date, is the following entry " a small colony of Terns is nesting on the West point of

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Miss E. L. Turner, F.L.S., F.Z.S., Hon. M.B.O.U.
Bird Watcher on Scolt Head Island, 1924 and 1925

the island : we found seventeen nests (with eggs) of the Common Tern, and nine of the Little Tern. There would seem to be some Sheld-ducks nesting on the area, as we saw fifteen on one mud-flat." Miss Turner was resident on the island this year during the months of May, June, September, and October, and incorporated in this report are the notes of her season's work. From these it will be evident that the island is not only an eminently suitable area as a sanctuary for breeding birds, but it is also an ideal observation spot on the direct line of the migration routes.

Since our last Report was issued, a small portion of the island —about an acre, situated on what is known as House Hill— has been planted with various conifers and flowering shrubs. In the centre is a small pond of fresh water, and it is hoped that this oasis will be resorted to by the passerine birds, which can be watched from the shelter of an old hut near by. The Committee here records its thanks to Mr. Douglas Carruthers for having carried out this planting, and to Mr. Chilvers of Hunstanton for the gift of some three hundred shrubs. It was noticed during the past summer that many small birds had already discovered the oasis, and resorted to it for drinking and bathing.

In the future, the island will be looked after by a whole-time Watcher, who will be in the service of the Committee. The National Trust is contributing £10 a year towards his wages, but there will be a heavy deficit to be met by the Norfolk Wild Bird Protection Fund, so that it is hoped that considerable additional financial support for bird protection in the county will be forthcoming next year.

The following Reports have been received from Miss Turner as to her work as Watcher on Scolt Head Island during 1925, and, in submitting these, the Committee desires to record its appreciation of the valuable services rendered by Miss Turner as Bird Watcher during the past two seasons.

Spring Migration at Scolt Head

Warblers.—Observations on the Spring Migration began on April 30th, the morning after my arrival. It is, of course, impossible to make accurate deductions with regard to migration as seen on the island after only two years' experience.

Nevertheless, it seems to me that very few warblers drop into the bushes, either during the Spring or Autumn migration. It is possible, however, that I may have struck two barren years, when owing to unfavourable winds and unsuitable weather conditions generally, few warblers touched this area. As was the case in 1924, warblers were only to be found in certain localities. The bushes in these places were visited daily until migration ceased.

Willow Warbler.—April 30th (wind S.S.E.) one. May 2nd (W.N.W.) two. May 8th (S.S.W.) one. May 13th (S.W.) one.

Wood Warbler.—May 8th (S.S.W.), one in the evening.

Chiffchaff.—May 8th, one with wood wren.

Whitethroat.—May 4th (S.S.W.), one. May 9th (S.S.W.) one sang softly at intervals, the only warbler I heard singing throughout the season. May 13th (S.W.), one.

Lesser Whitethroat.—Two on the evening of May 5th (W.N.W.), May 8th, (S.S.W.), two.

Wagtails.—The bulk of the yellow wagtails had passed before my arrival. A few were moving west on April 30th with a S.S.E. wind. May 3rd (N.W.), one. May 4th (S.S.W.), three. May 31st (W.S.W.), one. None were found nesting on the Island this year.

Pied wagtails had already taken up their residence. A few pairs only nest here, generally in marram grass, where it overhangs a bank. One nest was in a deep scrape practically on the ground. The depression must have been hollowed out by the birds and then filled with nesting material. The nest was well-concealed under thick marram at the base of a sandy hillock.

Wheatears passed singly, in twos, and threes every day up to May 19th, the prevailing wind being westerly. The latest spring record was on June 8th (N.E. fog), when one female came in at dusk.

Most of the birds we took to be the northern type from their size and bright colouring.

Hirundines.—Where not otherwise stated, the following passage migration of hirundines was from east to west, and the time, summer time.

May 1st (N.W., cold), one swallow.

May 2nd (W.N.W.), light breeze, swallows passing singly between 10 a.m. and 1 p.m.

May 3rd (N.W., light wind), hirundines passing all day. Between 12.45 and 2.45 the following birds passed over the Island :—250 swallows, 19 sand-martins, 1 martin. Sometimes they came singly, but generally in small parties, the greater number passed between 2 and 2.45 p.m.

May 4th (S.S.W.), cold and wet till 10 a.m., followed by warm, sunny intervals. Birds passing from 11 a.m. till dusk. Between 12 and 12.30, 135 swallows, 2 martins, 18 sand-martins ; from 12.30 to 2.45, 45 swallows, 11 sand-martins ; from 2.45 to 3 p.m., 31 swallows, 2 martins, 21 sand-martins ; from 3 to 3.7, 40 swallows, 3 martins, 20 sand-martins ; from 3.7 to 3.50, 67 swallows, 18 martins, 60 sand-martins, Then followed a five minutes' rush, when it was impossible to count the birds.

In estimating these numbers, we could only count those which passed over or round the island. The movement extended over a wide front, while the sand-martins kept chiefly to the edge of the sand hills by the shore and consequently many were lost to us. Many snapped at flies as they passed, but none lingered.

May 5th (S. till 10 a.m., W.N.W. later), steady migration from 6 a.m. till dusk. Birds leisured and feeding along the sandhills. The early morning was wet and cold, but improved later. The birds dropped low down to the harbour bar and crossed to the Brancaster Links side.

May 6th (S.S.W. squally), a steady stream all day, chiefly before noon.

May 7th and 8th (S.W. rain and much wind), very few passing.

May 9th and 10th, a steady stream all day (S.W., some rain).

May 11th (S.S.W., fine, cold), many passing all day, chiefly martins and sand-martins.

May 12th to 16th, very few. On the 14th, with a hot east wind, swallows passed between 7 and 9 a.m. There were no more that day.

May 16th and 17th (East wind like a hot blast from a furnace), thin streams all day.

May 18th to 24th (wind variable), very few.

May 26th (S.E., hazy), numbers of swallows.

May 27th (S.S.W.), wet and rough. A thin stream of swallows.

May 28th (S.W., windy, fine), swallows passing all day, and a few martins.

May 29th to 31st (W.S.W.), wind strong. Big rush each day, chiefly martins and sand-martins.

June 2nd and 3rd (W., warm), thin stream of martins and sand-martins.

Swifts.—

May 4th (S.S.W), between 12.30 and 4 p.m., fifty-four passed. Between 2 p.m. and 4 p.m. a big rush. Unlike the hirundines, swifts seldom passed over the col, but south of it, their line extending over the saltings. Few passed on the sea side of the sand hills.

May 5th, variable winds. Very few.

May 14th (E.), one only.

May 23rd (S.), one only.

May 24th (S., rough), seventeen.

May 28th to June 3rd (S.W. gales). These five days were the roughest I have known here. Each day swifts passed the Point in great numbers. The rush culminated on June 1st, when they swooped past in parties of 40 to 50 from 6 a.m. to 6.30 p.m. The biggest rush was between 12.30 and 2 p.m. All day they flew in the teeth of a gale. Owing to blowing sand, my outlook was very limited, and I could only see those which passed over head. These birds dropped low when they reached the Point and beat steadily against the wind with apparently little effort.

June 13th to 15th, a few only, with a constantly shifting wind, E.S.E. to S.W.

June 16th (W., warm), a thin stream all day.

June 17th (N.E., cold), three.

June 21st (N.), three. The last spring record.

Waders.—Common Sandpiper. May 5th, 9th and 14th, a few.

Turnstones in full breeding dress were recorded daily up to June 14th. They came in small parties of from three to

eight and seldom stayed more than a day or two. The force and direction of the wind did not seem to affect their movements.

Dunlin). From May 7th to June 8th a little flock in full breeding plumage haunted one spot. On the 20th and 22nd a flock of about one hundred slept for hours on the Point and rested there when not feeding. A few both in breeding and non-breeding dress remained till I left on July 2nd.

Sanderling. From April 4th till June 17tha few haunted the shore. Some of these were in transition plumage, but I saw none in full breeding dress.

Bar-tailed Godwit. On June 6th a party of about twenty flew straight in from the sea, north to south, just as I was laying down the law to a visitor, that the passage migration on this coast was from east to west ! The wind up to a few minutes before their incoming was due east, light and warm. It suddenly shifted to the north and rose with great violence.

Greenshank were recorded on May 17th and 18th with a north wind ; on the 22nd with an east wind, and on June 28th with a light northerly breeze.

Whimbrel were seen on April 30th and every day till May 19th, the prevailing wind being south west. The greatest number in one party was eight on May 15th (east wind and fog). On June 5th (E,), one. In 1924 and 1925 one whimbrel could always be found in a certain patch of marsh if there were any about, both during the spring and autumn migration.

Curlew were very scarce up to May 21st, when a flock of sixty came in with an east wind.

Grey Plover. May 5th (W.N.W.), one ; May 21st (E.), four, in full dress ; June 8th and 11th (N.E., fog), three from north, dropped into Northern Creek.

Knot. On May 2nd and 15th a party of eight in transition plumage. A few throughout the month, but none in breeding dress.

Black-throated Diver. May 13th (S.W.), three in full breeding plumage on the sea. Two appeared to be courting the third. They raised and lowered their heads after the manner of the great-crested grebe when courting. Finally,

one bird was driven off and as it flew the white markings on the wings were visible. This bird dropped into the sea and continued calmly swimming eastwards. The other two followed slowly. Most of the divers moved from west to east. May 21st, two divers.

Great-crested Grebe. Several on the sea up to May 14th, generally moving eastwards.

Gannet. Three on May 18th. One immature soaring over the Head, June 1st, in a strong W.S.W. wind.

Short-eared Owls. From May 11th to 19th one could always be seen hunting over or near the House Hills. On June 15th and 16th one barked at and followed us away from the ridge. On June 26th two birds followed us. Obviously they must have nested in the neighbourhood. Unfortunately, I had no time to hunt the big area beyond the hills. In all probability they nested over the Creek and not on the Island. I never saw them carry food away, but my observations were confined to the early morning.

Montagu's Harrier. Throughout June a fine male hunted the island. On the 8th it was quartering the marsh below the hut for half an hour, mobbed by redshanks, ringed plover, and sheldrakes. On one occasion I saw it chased away from the hills by all the sentinel sheldrakes in the neighbourhood—some sixteen birds. On June 12th the harrier was quartering the hills for rabbits. I saw it stoop at and miss a young rabbit. I last saw it on June 28th. Eventually, it was shot inland, as was the case with the one last year.

Kestrel. Resident and migratory in the neighbourhood. It is difficult to be certain of their movements. A tired bird flushed in the marrams off Smugglers' Gap on May 5th must have been a passing bird. Throughout May and June one or two, and sometimes three kestrels might be seen hovering over the hills.

Butterflies.—On June 4th the wind shifted from west to east at 2 p.m. Almost at once, the sky was full of white cabbage butterflies. They came flickering past like bits of white paper. There was a continuous stream during the whole afternoon till dusk. Clouds of them were flying high up and only just visible to the naked eye. Those which came along the sandhills to the Point crossed the sea near

the harbour bar. With my glasses I could see a continuous stream of these butterflies further out at sea, all flying west, before the east wind.

Notes on the Breeding Birds on Scolt Head Island, 1925

Sandwich Terns began to arrive on May 2nd as against May 20th in 1924. The birds came in at intervals in great numbers. On May 4th there were ten pairs, on the 13th, there were sixty birds sitting in a bunch contemplating *one* egg. On the 18th there were thirty-five eggs, and on the 22nd, 173 eggs. By June 1st there were 640 nests, more than half of which contained two eggs. There was one clutch of three nearly white eggs, evenly spotted with dark brown. There were also two other clutches of threes, both very handsome clutches, stone coloured, with great splotches of dark brown. There were two clutches of two pure white eggs. With the exception of six nests, all the double clutches were matched eggs. There is an interval of two and sometimes three days between the hatching of the first and second egg.

I saw the first young on June 9th, and by the 15th there were a number of young. I re-counted the *eggs* on the 16th, and there were 341 doubles, 257 singles, and three triplets. The majority were due to hatch on the 18th, and by the 19th most of the young were out except those in the middle colony. Unfortunately the gales and rain of June 18th and 21st, and the rough weather which prevailed till the 27th, destroyed a great number of young and spoiled most of the unhatched eggs. It was impossible to prevent people from collecting drift wood which came in with the rough tides. Every day the birds were put off their nests for an hour or more, several times a day. But for this I believe many of the young would have survived. Blown sand is fatal to eggs which are chipping, and also to nearly-hatched young. The nestlings have a better chance of surviving than young Common Terns. They are lethargic, and sociable. We often found three or four crowding together in one nest, and sometimes eight or ten would huddle together in a hollow scooped out beneath a tuft of sea rocket, thus keeping warm, and sheltered from blown sand.

Both the eggs and young varied considerably in general colouration and markings. But for the rough weather we should have made many notes on these points. It would be interesting to observe the relation between the colour of the eggs and the chicks. As the result of somewhat casual and general observations, we came to the conclusion that, more often than not, the ground-colour of the egg is repeated in the general colouration of the chick when first hatched.

On July 1st, just before leaving, I examined a few chicks, and only wished it had been possible to carry on the observations.

No. 1. Seven days. Sand-coloured bird, bill yellow, legs grey, yellow and buff down exactly like sand and shingle.

The following were all three-day old chicks.

No. 1. Brilliant orange bill and legs.

No. 2. Mauve beak and legs.

No. 3. Chinchilla-coloured down. Pale flesh-coloured beak and legs.

No. 4. Bluish beak and legs.

No. 5. Black beak, flesh-coloured legs.

No. 6. Stone-coloured down, from stone-coloured egg, lavender-grey bill and legs.

No. 7. Very dusky, blotched brown bird from similar coloured egg. Beak grey and legs slate-coloured.

These observations are too casual to be of any value, but, carried out systematically, they would be of considerable interest.

When I paid a visit to the Ternery on July 15th, there was a most adorable crowd of between five and six hundred half-grown Sandwich Terns massed on the far Point. We stole up to them, when they formed three groups and ran up and down the shingle shoulder to shoulder, or stood motionless in beautifully-dressed ranks and stared at us. Finally they took to the shallow water in several flotillas and swam away. As fast as they were able, that is to say, when the young were a week or ten days old, the Sandwich Terns brought their young from the Point to the low sand hills near my look-out tent. They then occupied practically the whole of the Ternery and spread along the shore eastwards.

They all left the breeding ground some time during

the second week in August, perhaps owing to a shortage of whitebait in the harbour. But as they nested early this year, in all probability the young were ready to depart. In 1924 the few pairs of Sandwich Terns which nested at the Island, did not begin seriously to lay till June 10th, when there were twenty nests, which increased to fifty by June 30th. This year the birds were all due to hatch before the end of June, with the exception of a few which were robbed on Whit Sunday. Up to September 9th, numbers of Sandwich and Common Terns were reported to me as fishing off Holm " Well " and following the fishing boats all day, and returning to Holm Marshes at night. Up to October 6th we noted a few daily, mostly immature birds, most of them going west. On September 23rd, there were at least fifty resting on the Point, but these had gone away the next morning. In 1924, there were a few passing daily up to October 15th, the day I left.

Common Tern.—I saw the first Common Tern on May 4th, when there were four pairs on the beach. The first eggs were laid on May 17th (May 16th, 1924). On May 22nd, there were eighty nests, and at the end of the month we estimated that there were nearly seven hundred nests. The first birds were hatched on June 1st, and by the 11th there were many young birds. The greater number were due to hatch on the 18th. A too prematurely cheerful note in the diary says " No rain during the whole time the terns have been brooding." Unfortunately a week of very rough weather, ushered in on June 18th, with a gale from the North and an abnormally high tide, practically destroyed almost the whole brood of Common Terns. All day on the 18th the terns seemed unable to procure food, and during that week we buried whole families of young ones, both the newly-hatched, and birds fifteen days old. The mortality amongst Common Terns is always great, because so many of the nestlings are either crushed in the nest or pecked by neighbouring birds, or choked with food. Common Terns are foolish parents. Sometimes they quarrel over which of them shall feed the babies and meanwhile trample them to death. The time adult terns spend in chasing and trying to rob each other of a fish would often be better employed in fishing for themselves and their young.

Before I left on July 1st, many Common Terns had nested again, and when I paid a flying visit to the Ternery on July 15th, there were about two hundred nests.

ROSEATE TERN.—One Roseate Tern came in on May 19th, and after calling up and down the beach for two days, generally with a fish as an offering to his prospective mate, the second bird appeared.

I found the first egg on May 31st, and the second on June 2nd. The first nestling hatched on June 24th, but succumbed in the heavy gales between the 25th and 26th. The second was hatched on the 27th, and was a healthy nestling when I left on July 2nd. On the 15th, when I paid a flying visit to the Island, there was no sign of the Roseates, old or young.

LITTLE TERN.—Little Terns had arrived by April 29th, and continued to come in during the next ten days. The first eggs were found on May 19th (May 20th, 1924). There was a marked increase in their numbers this year. In one area alone there were thirty nests as against nineteen in 1924. Fortunately, the chief colony was protected from the normal tides by a high bank of shingle. This bank, which had formed earlier in the year, extended for about a quarter of a mile, and the terns nested along its edge. The eggs in these nests were all hatched by June 13th. On June 18th there was an abnormally high tide and a very rough sea. The north wind piled the water over this temporary ridge and flattened it out. But the young lesser terns were many of them crouching in the marrams.

In another area we found eight nests where there were only four last year. Several of these were destroyed inadvertently by a picnic party of children and adults, on Whit Monday.

Little Terns seem to like nesting in detached groups of from five to seven pairs, roughly speaking. There were more of these little colonies everywhere this year. One nest contained four matched eggs. Another contained two normal eggs and one stone-coloured egg with a single dark spot at the large end.

During the heavy gales which raged from June 21st to 24th, I found many dead nestlings. However, there were quite a number of young birds running about the shore when I left on July 2nd.

The long ridge area had been jealously guarded while the birds were sitting, but a few days after the young had hatched a local party landed with two children and persisted in hunting for driftwood. For half an hour they trampled all over the shingle where tiny little terns were crouching, in spite of the watcher's request that they should move out of the danger zone. The results were disastrous.

Skylarks, Pipits, and Linnets.—Skylarks, Linnets, and Meadow Pipits were ubiquitous ; they all, and especially the Meadow Pipits, suffered badly from the depredations of carrion crows and rooks. I have more than once seen a crow lift a sitting Meadow Pipit off its nest, carry it to the marsh and devour it while the pipit's mate flew screaming round and round the marauder. Eggs, and young and old, were all food for these robbers.

Ringed Plover.—Ringed Plover nested all over the shingle ridges, amongst the marrams, and on the tern beach. As was the case in 1924, all the exposed nests on the south side of the hut were destroyed by passing carrion crows, and by rooks from the mainland. The only nests in this area which escaped were concealed under suæda bushes. We tried the experiment of shielding exposed nests with branches of suæda, but although the eggs in these survived longer than many, eventually they too were destroyed. But those Ringed Plovers which nested amongst the terns were not subjected to the depredations of crows. I only once saw a carrion crow invade the Ternery, that was on June 12th. The entire population rose and drove it away. One stout-hearted Little Tern followed it right up the Channel long after the rest of the birds had given up the chase.

Lapwings.—There was an increase in the number of nesting Lapwings. In all, ten nests were found, but three of these were second, if not third, attempts, as they were not found till June 2nd.

Redshank.—A fair number of Redshanks nested this year. Most of the nests were in marram, and some of them on high and dry sandhills. On May 4th I found a nest with four eggs in a very open situation near the edge of the tide in one of the bights. This hatched on the 18th. There were three nests close to my tent, all of which hatched off. On June 1st I saw

two Redshanks bullying the Common Terns and driving them away from a small sandhill, evidently newly-hatched young were being tended there for a time. The young Redshanks are taken away to the Saltings as soon as possible, and there hidden in the tangle of sea purslane. At the high spring tides I have seen young in all stages of growth swept up towards the hills, hiding under the marram until the tide turns, when they are quickly led back down the drains to the coarse vegetation. Whenever a marauding bird passes over the Saltings it creates a great disturbance amongst the adult Redshanks. By the end of June the Redshanks begin to flock and the numbers of the resident birds are augmented by incoming birds.

Oyster-Catchers.—Up to May 18th there were from twenty to thirty Oyster-catchers on the Saltings. Of the six and possibly seven resident pairs, we only found four nests. Two pairs successfully eluded us, although we found several excellent scrapes and even lined nests in their breeding area. Sometimes they make quite elaborate false nests beautifully lined with bits of blue mussel shells, and then ultimately lay their eggs in a mere depression on the shingle. Of all birds they are the most elusive and exasperating, and take an evident delight in fooling human beings, for they will often chase you away from their breeding grounds with a derisive chuckle.

No. 1 nest contained one egg on May 19th, and four eggs on the 24th. On June 17th one nestling was cheeping in the egg, and on the 19th at 10 a.m., all were cheeping loudly. At 8 p.m., three chicks were out ; the fourth egg did not hatch (incubation twenty-seven days).

No. 2 nest. On May 22nd there were three eggs, and four hatched on June 19th. Two only of these nestlings survived the gales of June 23rd and 24th.

No. 3 nest. One egg on May 27th, two on the 29th, and four on June 3rd. On June 26th two young were cheeping, and on the 28th two hatched.

No. 4. This nest was not found till June 5th, when it contained three eggs. On June 15th, 16th and 17th, the chicks were cheeping loudly though the eggs showed no sign of chipping. On June 18th two hatched, the third was cold.

As this nest was almost in the fair way to the hut, the wonder is that any of the eggs hatched. There are no records of these young birds after June 30th.

SHELDUCK.—There were about twenty pairs of Shelduck nesting between Brancaster Harbour and the north side of the House Hills. Several nests were quite near the hut, and in spite of our proximity, the owners of them became—for Shelduck—quite confiding.

At 6.30 a.m., on June 27th, I saw a party of ducklings emerging from one nest, and I managed to catch four, but the duck had hustled the others back into the hole, nor did we see them come out again. We hid for some time behind a sandhill, while the drake stood on the Saltings watching and directing. From his behaviour it was obvious that the duck led her brood across the Long Hills to the shore, instead of conducting them across the Saltings, as was her original intention.

On June 29th, while at breakfast, I saw another brood being led to Norton Creek by both parents. There were nine ducklings, one behind the other, headed by the duck while the drake brought up the rear. When moving in a string and running quickly, as they always do, these mottled balls of down look like a large spotted snake wriggling over the marsh. As soon as a drain is reached the brood tumbles into it, and their journey to the water is continued under cover. Sometimes they run over the marsh in extended formation, with a parent at either end of the line. The sheldrake is the only British drake that takes any real interest in his family. Some time after they are fledged he continues to guard them.

The broods this year were on the whole fairly large ones, as I frequently saw broods of ten and thirteen in the creeks, as well as smaller families.

BLACK-HEADED GULLS.—In 1924 one pair of Black-headed Gulls nested in the Ternery. This year there were six nests, and a possible seventh further east. Of these six nests, four were on the top of tiny sandhills, and two on the flat shingle. One nest contained only one egg, and the nestling was trampled to death almost as soon as it was born. Two nests hatched on June 11th. On the 13th and 14th, I moved the remains of nine young Common Terns from one nest,

and two from another. I found no remains of terns in four out of the six nests at any time, but as the young gulls are hidden in the marrams until they are vigorous, no one can say with certainty what takes place. In any case, it is a mistake to allow Black-headed Gulls and Terns to breed together.

Wolferton

We visited this Ternery on July 12th, where we were met by Keeper F. Bridges. There was a slight increase in the number of terns' nests this year, estimated by Bridges to be a total of about eighty nests, some twenty of which were nests of the Little Tern. The birds had hatched off well, and at the date of our visit, most of the birds had left. We saw only three or four Common Terns during the afternoon. We regret to have to record the death of John Bland of Wolferton Wood, who had acted as one of the Watchers on this area for the past three years. He is succeeded by Mr. T. Gamble.

A Woodland Bird Sanctuary

In our Report for 1923, reference was made to a newly-formed bird sanctuary of about seven acres of woodland in the parish of S. Wootton, near King's Lynn, where Mr. N. Tracy, the owner, has built himself a bungalow in which he resides. During the past two years we have had the pleasure of revisiting this sanctuary on occasions, and of being shown by Mr. Tracy the various further bird attractions, in the shape of a pond, etc., which he has added. Mr. Tracy has been well rewarded for his labours, as will be seen from the following list of 101 nests of twenty-three different species of birds which he found in his wood this year :—

Tree-creeper ...	6 nests	Blackbird ...	4 nests
Great Tit ...	9 ,,	Song-thrush ...	4 ,,
Blue-tit ...	6 ,,	Mistle-thrush	11 ,,
Coal-tit ...	1 ,,	Wood-pigeon	6 ,,
Marsh-tit ...	1 ,,	Turtle-dove	2 ,,
Wren	4 ,,	Redstart ...	5 ,,
Hedge-sparrow...	2 ,,	Willow-wren...	5 ,,
Robin	3 ,,	Pheasant ...	5 ,,
House-sparrow	1 ,,	Goldcrest ...	1 ,,
Chaffinch ...	17 ,,	Spotted Flycatcher	2 ,,
Starling ...	3 ,,	Pied Wagtail	1 ,,

Lesser Redpoll ... ... 2 nests

In a letter received from him after a visit in July he says :— " I do not suppose this is a complete list, as I was away from home during the greater part of May, and so it is quite possible that I overlooked a good many nests. Although I have now had the wood for four years I had not once, until Good Friday, seen a House-sparrow in it, although I had always been on the look-out for one. On this day a cock bird appeared, and on the next it brought its mate, and they eventually built a nest under the tiles on my roof. The Wood Warbler, as usual, nested just beyond my boundary, as also did a Greater Spotted Woodpecker. I had three pairs of Redstarts and five nests. One pair had two broods ; they started to build the second nest before the young birds had left the first. In addition, I found two Redstarts nests just outside my wood, one of them built in a stack of timber."

A pair of Crossbills had their nest this year a few hundred yards from the boundary of his wood and " on June 22nd, a family party of six Crossbills visited the wood, and were very busy with the Scotch Fir cones, but I did not see them again after this date." Mr. Tracy goes on to say that " this year seems to have been a very good one for migrants. The following birds have been unusually numerous about here ; Chiff-chaff, Wood Warbler, Whitethroat, Blackcap, Garden Warbler, Wheatear, Yellow Wagtail, Turtle Dove, Nightingales, Cuckoos, and Swallows, were up to their usual strength, but House Martins seem to be getting very scarce.

A friend of mine found fourteen Red-backed Shrikes nests in a very small area in the —— district (mentioning a part of Norfolk not very distant), but they do not seem common around Wootton. About the middle of April I put up a Woodcock, and a pair were seen near the same place during May by a gamekeeper."

The Broadland District

The year 1925 may certainly be described as a good year for the nesting birds in Broadland. It would be impolitic to name localities where only some of the rarer birds are to be found, but from reliable information we are able to state (1) that the number of nesting Bitterns shows no signs of diminishing, and that this species is most jealously guarded

throughout the breeding season ; (2) that there were several nests of the Montagu Harrier ; (3) that the Short-eared Owl now nests in at least two widely-separated localities in the county ; (4) that there appears to be rather a diminution in the number of Bearded Tits, at any rate in some parts of the Broads district. The prolonged cold of the winter 1923-24 probably caused an undue mortality amongst these birds ; (5) that there were more pairs of Yellow Wagtails nesting in Broadland this year than have been noted for some years past ; (6) that five nests of the Garganey were found, two of which, containing eight and ten eggs, were seen by the writer on May 28th ; (7) that the Great Crested Grebe is now so commonly distributed all over the Broads district that it would be impossible to give anything like a correct census of its nests.

Alderfen Broad is still the only Broad on which the Black-headed Gull nested in 1925. We visited this Broad with the owner, Mr. Herbert Goodchild, on May 14th, when we estimated that there were about two hundred nests. The nests were more widely distributed over the Broad this year, a few of them being on floating hovers down to the entrance to the Boathouse Dyke. Mr. Goodchild reports that the birds hatched off well, and were not interfered with by otters ; but the pike, of which he says there are too many in the Broad, take heavy toll of the young gulls and ducklings. An attempt to prevent overcrowding amongst the young gulls was also made by a pair of Montagu's Harriers that were nesting on an adjacent marsh. A pair of Tufted Duck remained on the Broad until May 9th, but there is no evidence of their having nested in the district.

Breckland

We paid a visit to Scoulton Mere on March 15th, when we found that the Gulls had roosted on the mere for the first time this season, on the previous night. Between one thousand and two thousand birds were in occupation. As is well known, the nests are usually limited to the " Hearth " i.e., to the reed-bed on the north end of the island ; this year there was an overflow of four nests on to the mainland. A month later, at Breccles, we found about one hundred Gulls at this recently-formed Gullery, which is doubtless an off-shoot of Scoulton. We have no information as to whether or not these birds were

allowed to nest. As bearing upon the attempt of the Redstart to re-establish itself in Norfolk (see Mr. Tracy's observations on p. 75), it may be recorded that on April 26th, Mr. A. Holte Macpherson found a pair of these birds and, in addition, seven cock birds, in a small circumscribed area in Breckland. We visited this district several times later and, although we never succeeded in finding a nest, we have little doubt that some of these birds, which remained throughout the summer, nested in the locality.

The only place in the county known to us where the Common Curlew breeds is Roydon Fen, where a nest was found some few years ago by Mr. N. Tracy. During the past summer Mr. W. H. Thorpe, of Jesus College, Cambridge, paid several visits to a certain part of the Breckland district where, he writes, " we of course found Stone-curlew nesting in numbers, but we were also very surprised to find Common Curlew on several occasions. We never found a nest, and we do not know for certain that they were nesting, but it seems probable that they were."

Signed (on behalf of the Norfolk W.B.P. Committee),

SYDNEY H. LONG, HON. SEC.

LIST OF SUBSCRIPTIONS AND DONATIONS TO THE NORFOLK WILD BIRDS PROTECTION FUND FOR 1925

	£	s.	d.
H.M. THE KING ...	3	3	0
H.R.H. THE PRINCE OF WALES, K.G. ...	2	2	0
Adcock E. D.... ...	1	1	0
Agnew C. G.	1	1	0
Allars R. W. E. ...	3	3	0
Allen J. L.	0	5	0
Andrews W. H. M. ...	0	10	0
Anonymous (Special Donation)	5	5	0
Ash Mrs. (Terns' Food Inquiry)	2	2	0
Baker E. Stuart, O.B.E.	2	2	0
Barclay F. H. ...	1	0	0
Barclay H. G. ...	2	2	0
Barry W. J.	1	1	0
Carried forward	24	17	0

	£	s.	d.
Brought forward	24	17	0
Barton S. J., M.D. ...	1	1	0
Bedford Her Grace the Duchess of	2	2	0
Bidwell Edward ...	0	10	0
Blakeney Point Collecting Box ...	3	4	0
Boardman E. T. ...	0	10	0
Boileau Lady (the late)	1	1	0
Boileau Sir M. Bart.	1	1	0
Brash T (£2 2 0, plus special donation £2 2 0) ...	4	4	0
Brittain H.	0	10	0
Brooks J. R.	1	1	0
Brown Edward ...	1	1	0
Brown Henry ...	1	1	0
Carried forward	42	7	0

	£	s.	d.
Brought forward	42	7	0
Buckle Lt.-Col. D. W.	1	1	0
Burrows Mrs. (Terns' Food Inquiry) ...	2	0	0
Burrows R. B. ...	0	10	0
Burton S. H., F.R.C.S.	2	2	0
Buxton E. G. ...	2	2	0
Buxton E. N. ...	1	1	0
Buxton G. F. ...	3	3	0
Buxton Walter L. ...	1	1	0
Byers J.	0	5	0
Carruthers D. ...	2	2	0
Cassie R. L.	0	10	0
Castle J. W. (Special Donation)	35	0	0
Chamberlin Sir George	1	1	0
Chapman, E. H. His Honour Judge ...	2	2	0
Christie J A., M.P. (for Terns' Food Inquiry)	1	0	0
Coe Mrs A. E. ...	0	10	0
Coller G. A.	1	1	0
Colman Miss Ethel ...	1	1	0
Colman Miss Helen C.	1	1	0
Colman R. J. ...	1	1	0
Cooke A., F.R.C.S. ...	0	10	0
Cozens-Hardy A. ...	1	1	0
Cresswell Col. George M.V.O.	2	2	0
Currie Lt.-Col. J. W....	1	1	0
Davey G.	0	10	0
Deacon Dr. G. E. ...	1	1	0
Dew Mrs. ... ... (plus £1 1s. 0d for Terns' Food Inquiry)	0	10	6
	1	11	6
Doughty C. G. ...	1	1	0
E. B. S.	1	0	0
Ferrier Miss Judith ...	0	10	0
ffolkes Sir William, Bart.	1	1	0
Fleming Miss Rosemary	0	10	6
A Friend	0	5	0
Gadesden Miss ...	0	10	0
Gayner Dr. J. S. (Terns' Food Inquiry) ...	3	3	0
Gay Miss C. E. ...	1	1	0
Giles C. C. T. ...	0	5	0
Gossage Col. W. W. ...	2	2	0
Green Major E. A. Lycett	0	10	0
Gunn Donald (Terns' Food Inquiry) ...	1	1	0
Gurdon E. T. ...	1	1	0
Gurney A. E. ...	1	1	0
Gurney G. H. ...	1	1	0
Gurney Mrs. Richard	0	10	0
Carried forward	127	0	6

	£	s.	d.
Brought forward	127	0	6
Gurney Robert ...	1	1	0
Gurney W. S. ...	1	1	0
Halls H. H.	1	0	0
Hannaford G. ...	2	2	0
Harcourt Miss J. Vernon	1	1	0
Harding J. Rudge (10s. for Terns' Food Inquiry)	0	15	0
Hare Sir Ralph, Bart.	1	1	0
Harker W.	1	1	0
Harmer Bertrand ...	1	0	0
Haydon W.	0	5	0
Horsfall R. E.	0	10	0
Howard R. J. ...	1	1	0
Jones Sir Lawrence, Bart.	1	1	0
Kennedy Mrs. Watson (Terns' Food Inquiry)	1	1	0
Ketton-Cremer, Wyndham C. ...	0	10	6
Kinder Rev. E. H. ...	1	1	0
Knight E.	1	0	0
Leconfield Lady (Terns' Food Inquiry) ...	2	2	0
Lee-Elliott Rev. D. L. and Mrs. (Terns' Food Inquiry) ...	2	2	0
Lee-Elliott Rev. D. L.	1	1	0
Lloyd Captain L. ...	0	10	0
Long Miss	0	5	0
Long F.	0	5	0
Long S. H., M.D. (plus special donation of £5 5 0)	7	7	0
Longstaff Capt. Tom G. (special donation)	1	1	0
Lucas Dr. Geoffrey ...	1	0	0
Lyon Maj. C. E. (Terns' Food Inquiry) ...	1	1	0
Mack H. P.	1	1	0
Macpherson A. Holte £1 1 0 plus £3 3 0 for Terns' Food Inquiry	4	4	0
Massingham H. J. ...	1	0	0
McKenna Mrs. Reginald	1	1	0
McKenzie Miss G. ...	0	10	0
Meade-Waldo E. G. B.	1	1	0
Meadows Mrs. A. H....	0	10	6
Mennell E.	0	10	0
Murton Mrs.	1	0	0
Miller O. T.	0	5	0
Millett C.	1	0	0
Carried forward	172	8	6

	£	s.	d.
Brought forward	172	8	6
Moxey J. E.	1	0	0
Newman Miss F. B. ...	0	5	0
Norton Lt.-Col. E. F., D.S.O.	5	0	0
Offord Miss G. E. W.	0	10	0
Oliver F. W., R.R.S. (£1 1 0 plus £2 2 0 for Terns' Food Inquiry)	3	3	0
Oswald Nigel A. ...	3	0	0
Pain P.	1	1	0
Patteson Mrs. F. E. ...	1	1	0
Pelham Rev. Canon S.	2	2	0
Plowright Dr. C. T.	2	2	0
Pond H. J.	1	1	0
Preston Sir Edw. Bart., D.S.O.	1	1	0
Purdy Col. T. W. ...	1	1	0
Pym Mrs.	0	5	0
Ransome Mrs. ...	1	1	0
Reeves Hugh ...	1	1	0
Reid Dr. E. A. (Terns' Food Inquiry) ...	0	10	0
Richmond H. W., F.R.S.	2	0	0
Ringrose Bernard ...	1	1	0
Rising A.	2	2	0
Riviere B. B., F.R.C.S.	2	2	0
Robertson W. K. ...	0	10	6
Rogers Rev. H. ...	1	0	0
Scolt Head Collecting Box	5	17	1
Sewell P. E.	2	2	0
Carried forward	214	7	1

	£	s.	d.
Brought forward	214	7	1
Simpson F. T. ...	2	2	0
Smith Col. H. F. ...	1	1	0
Smith E. Vardon ...	1	1	0
Soman A. E.	1	1	0
Soc. for the Promotion of Nature Reserves, The (for Terns' Food Inquiry)	2	2	0
Spalding G.	0	10	0
Stimpson E.	0	10	0
Strachan C. E. ...	1	1	0
Sumpter Dr. B. G. ...	2	2	0
Taylor Dr. Mark ...	1	0	0
Thackrah Miss M. ...	0	2	6
Thouless H. J. ...	0	10	0
Upcher H. E. S. ...	1	0	0
Upcher Miss L. ...	2	0	0
Vincent T.	0	1	0
Walter C. H. ...	1	1	0
Walter J. H.... ...	1	1	0
Washington Rev. Canon M.	1	1	0
Wells C. H.	1	1	0
Willett W. L.... ...	0	5	0
Winch Major S. B. ...	2	2	0
Wright B. D. Z. ...	0	10	0
Wright T. J.	0	10	6
Wyllys H.	0	10	0
Wyllys W. E. ...	0	10	0
Total	£239	2	1

NORFOLK WILD BIRD PROTECTION FUND

Year ending December 31st, 1924

RECEIPTS

	£	s.	d.
Balance from 1923	53	3	7
Subscriptions	153	9	7
Collecting Boxes, Scolt Head and Blakeney Point	11	9	9
	£218	2	11

EXPENDITURE

	£	s.	d.
Watchers—Breydon	38	10	0
Scolt Head	33	17	10
Blakeney	25	0	0
Wolferton	10	0	0
Horsey	1	0	0
N. & N. Nat. Society, Printing Report	10	0	0
Miss Turner, for Expenses ...	5	0	0
Repairs to Hut, Wolferton ...	0	14	0
Secretary's Expenses	4	8	6
Cheque Book	0	4	10
Transfer to "Nature Reserve Purchase Fund"	75	0	0
Balance at Bank	14	8	7
	£218	2	11

VIII

THE COLOUR OF THE IRIS IN THE HAWFINCH

By R. J. Howard

Whilst recognising the difficulty in giving the true colours of the irides of living birds, and knowing the great change in the colour of the eyes which takes place in many birds when unduly excited and also after death, I am convinced that the description of the iris of the Hawfinch as greyish-white is incorrect.

In the spring of 1884, I learned that the Hawfinch, then extending its range in this district, had been seen during the winter at Redscar, an estate some ten miles away. As I wished to make sure that I was right in thinking a mistake had been made by those who described the colour of the irides as greyish-white, I ran over to Redscar on the 5th April, and saw Billington, the gamekeeper, who told me that he thought Hawfinches had been about all winter.

He had noticed that a considerable quantity of the Indian corn, put down for the pheasants, had been split, and the soft germinating portion eaten. He then kept watch from his cabin and saw that it was the work of Hawfinches. About seven birds, male and female, came to the feed daily; the males, with tails expanded, drove off all intruders. So shy were the birds, that although he had been gamekeeper on this estate for seventeen years, he had never noticed them until he saw these from his cabin. He promised to try and catch one or two for me, and succeeded in capturing one, on the 21st. On the 23rd, he walked over from Redscar, arriving at my house at 8 a.m. with an adult male, in a small cage, wrapped in a handkerchief. The bird was in capital plumage and remarkably tame, it had cracked a handful of maize which Billington put in the cage on leaving home. This is typical of the bird, extremely shy and wary when at large or in an aviary, but remarkably tame when kept in a small cage.

On the 7th August, one of my Merlins dashed from his bath at the Hawfinch. I picked up the bird from the cage floor, as I saw it was dying, and paid particular attention to the

colour of the irides ; the madder brown kept getting gradually lighter, until at last, before the bird was cold, the colour could only be described as greyish-white. I had often held the bird in my hand and found the colour arranged in concentric circles, those nearest the pupil being lightest, the intensity of the colour varying when I teased the bird. This change in colour was accompanied by rapid dilation and contraction of the pupil.

I have taken every opportunity of seeing caged Hawfinches and at various bird-shows have examined birds in the best condition, steady—not showing excitement when closely watched—and have invariably found that the eyes were as I have described above.

Ten days ago a Cage Bird Society's Show was held in this town at which four male Hawfinches were exhibited. I took with me the volume of Thorburn's " British Birds " (2nd edition), containing the plate of the Hawfinch, and it was my opinion and that of several friends, that the colour of the eyes of the birds could not be better rendered than as given by the artist.

It may be argued that the " Colour feeding " of cage birds kept for exhibition purposes may affect the colour of the eyes, as it undoubtedly does that of the feathers. Fortunately, I have had exceptional opportunities of watching wild birds at close quarters, and have been able to prove that this is not the case. On the 8th January, 1922, my daughters saw a bird, which they thought was a Hawfinch, fly from one of the old hawthorns which overhang a corner of the stable yard. Examination of the ground underneath, which I found littered with the symmetrically split shells of the haws, convinced me that they were right.

On the early mornings during the following March, and on many subsequent occasions up to the present autumn I have watched the birds—sometimes a pair—from an open bedroom window, through field-glasses at distances varying from eight to a dozen yards. The colour of the eyes I found to be the same as that of the caged birds.

On the 8th February, 1924, we watched a male Hawfinch at work in the thorn for over half an hour, and were struck with the methodical way in which he moved among the thorns. When reaching for a haw below his perch he hung head down-

wards, stretched at full length as a parrot would ; mostly he pulled the berry quickly with a slight twist of the head, at other times he had to shake it rapidly at the apparent risk of blinding himself against the surrounding thorns. The average time taken in pulling the berry, stripping off the pulp, and dropping the halves of the neatly split shell occupied nine seconds. The bird was so tame that he allowed the gardener to pass under the thorn twice without leaving it.

The dates between which Hawfinches have visited the hawthorns are the 17th October—the day on which I am writing these notes, when a single bird is in the thorn—and the 8th April when the last of the haws were taken.

Walter Charlton in his ANOMASTICON ZOICON, published in 1668, gives an excellent figure of the Hawfinch with a dark eye. This figure is reproduced in British Birds (Mag.) Vol. XV., p. 162.

The beautiful little woodcut by Mr. G. E. Lodge in Lord Lilford's " Birds of Northamptonshire," gives a dark eye.

A photograph of an adult male in the " Birds of Yorkshire," shows the bird with a dark eye.

Seeing that the coloured plate in Kirkman's " British Birds " shewed the male Hawfinch with eyes of practically the same colour as that which I gave, I wrote Mr. G. E. Collins, the artist, who in his reply, dated October 1920, says :—" I would describe the colouring of the irides of a Hawfinch as a rich red brown ; certainly white, as so many authors have it, is incorrect."

In " The Zoologist " 1906, p. 109, this letter appears—Colour of the eyes in *Coccothraustes vulgaris*. In my " Catalogue of Shropshire Birds " published in 1897, occurs the following passage :—" In 1891 I caught a young Hawfinch at Caynton, which I brought up by hand and kept for a couple of years. I always noticed that, when angered, his irides were suffused with a much deeper purplish red tint than when he was quiescent." And in a footnote adds " I never saw the irides of a living Hawfinch greyish-white such as one sees in stuffed specimens, and which colour is only assumed at death. I write this because it bears out the interesting remarks of the Rev. Maurice C. H. Bird, anent the colour of the eyes in *Fuligula*

nyroca. Unfortunately, authors do not always confine their errors to colour of the irides."—G. H. Paddock (The Hollies, Haygate Road, Wellington, Salop).

In " Country Life," 16th September, 1922, appeared a letter from Mr. Ernest Blake, saying :—" Whilst watching these Hawfinches, my wife and I noticed that the colour of their eyes was vinous brown ; on looking up the authorities we found, as Mr. Robinson states, that some of them say the eyes are grey, though others give the colour correctly."

Mr. Thorburn wrote me on the 1st October, 1924 :—" With regard to the colour of the Hawfinch's eye, there is no question that it is the kind of brown you describe. Since the note I sent you in 1913, I have seen another live bird in the Edinburgh Zoo, which was similar to the Hindhead bird, and I have had other first hand information besides."

Frequently the first intimation which reached me that the Hawfinch had been met with in a particular district was that a specimen of this powerful bird had been picked up in a dead or dying condition. This apparently unaccountable mortality has been noticed by others. Mr. J. Gurney Barclay writes (Birds of Essex)--" This species first came under my notice about the winter of 1825, when a fine cock bird fell dead on the gravel walk before the gardener—from what cause was unascertained." The cause of the death of those which came under my own notice I could not make out, for judging from their condition, they were not starved.

The only reason I can conceive for so many authorities giving the colour of the irides of the Hawfinch as greyish-white is that it has been taken from dead or dying birds ; but that of the eyes of a healthy bird, unexcited, is faithfully given in Thorburn's " British Birds."

IX

SCOLT HEAD

By J. A. Steers

[*The following lines are intended only as an introductory statement of some of the problems which the writer hopes to examine in the future.*]

Scolt Head Island, which is so well known to all bird-lovers, offers very much of interest to the Geographer. It is hoped that a fairly extensive geographical investigation will be carried out in the near future. Much work is necessary in correlating the several lines of research.

This communication is intended only as a brief indication of the lines on which such an investigation may proceed. The accompanying map shews clearly that the west end of the island has been growing very rapidly of recent years. The map, which has been simplified, is based on the two editions of the Six Inch Ordnance Survey map. There are two editions of this map for the Scolt area ; the one published in 1891 and surveyed in 1886, and the other published in 1907 and surveyed in 1904. On the sketch the general distributions of shingle and dunes are shewn, together with the high and low water marks of ordinary tides. In order to keep the sketch as simple as possible, no distinction has been made between sand and mud. The addition at the extreme western end, that part added since 1907, has been traced from a rough plane-table survey made by the Botanical Party from Cambridge when staying on the island this summer. The sketch was on a scale of six inches to the mile. The shifting of the mouth of Brancaster Harbour is shewn on both the earlier maps, but not on the small sketch, which was made for botanical purposes only.

Assuming that the point A marked the end of the main beach in 1886, we find a growth of about 5,100 feet to the point B in eighteen years—an average annual progression of 283 feet. Between the years 1904 and 1925—points C to D—we have an accretion of about 3,150 feet in twenty-one years, or a yearly addition of about 150 feet. Speaking only of the main beach, the stretch between A and D, i.e., not

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Map Shewing the Westward Growth of Scolt Head Since 1891

allowing for the recurved ends, has been added in thirty-nine years, or an average annual progression of approximately 167.5 feet.

These measurements have been made from the maps noted. There is no particular reason to imagine that the leeward growth has been quite regular; doubtless in some years conditions were more favourable to rapid growth than in others. Furthermore there may have been periods of retrogression. Together with the westward extension there has been a driving landward of the main beach. This is clearly shewn on the sketch. Rough measurements suggest the distance lost varies between 100 and 170 feet, decreasing to nothing at F and also at another point similarly situated at the Burnham end of the island. Further study of the map reveals the fact that the dune areas within the main beach have extended somewhat, whereas the encroachment of the sea has correspondingly diminished those facing the main beach. The reason for the great differences in the amounts of shingle on the two maps is not clear. Perhaps no particularly clear distinction was drawn on the early map between the areas of mud, sand, and shingle, whereas more careful mapping was made on the later edition. This possibility is also reflected in other details.

These are only a few of the more obvious facts which result from a study of the island. A great deal remains to be done in considering (1) the reasons for these changes; (2) the sources of supply of the beach material; (3) the examination of the shingle from a petrological point of view; (4) the careful mapping of the yearly accretions to the island; (5) the effects of winds, waves, and tides on the growth of the beach. These and other similar problems need time and many observations, and must be considered before we can, with any degree of certainty, work out the geographical evolution of the island. One of the most immediate necessities to which the writer hopes to give attention next summer, is the careful mapping of all the older, and often dune covered, shingle bars which run back into the marsh.

NOTE.—The bar marked B on the sketch has really been driven back on to that marked M, which is a triple bar. This has not been indicated on the sketch because it was

desired to shew the actual outline of the 1907 map. One of those who surveyed the part added between 1907 and 1925 informed the writer that he saw no reason to think that this had any noticeable effect on the measurements given above. In any case the delineation of the extreme western end must be regarded as of much less accuracy than the remainder of the map.

X

THE VEGETATION OF SCOLT HEAD ISLAND A PRELIMINARY ACCOUNT

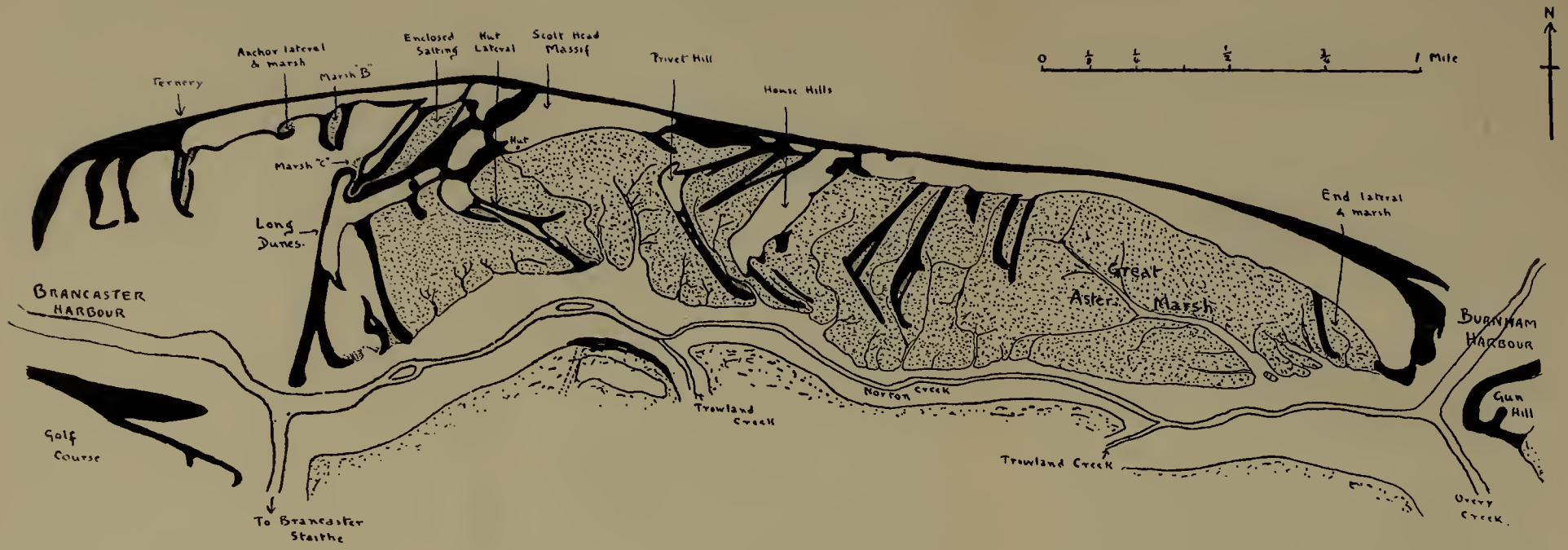
By F. C. Deighton and A. R. Clapham

I. Introduction
II. Structure
III. Shingle
IV. The Drift Line
V. Dunes
VI. Marshes
VII. Erosion of Dunes
VIII. Conclusion

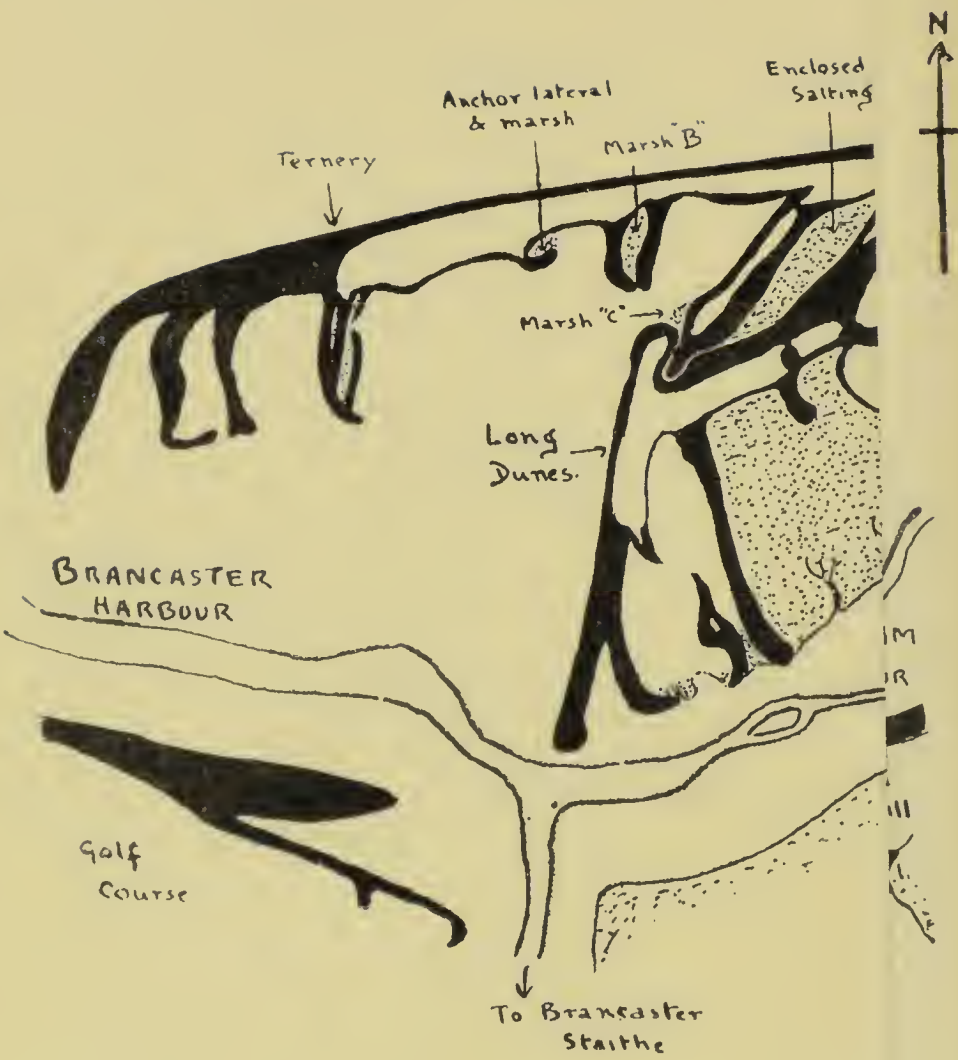
I

The following account has been written as the result of a stay at Scolt Head during July and the first part of August, 1925, when, Miss E. L. Turner being absent, it was necessary that someone should be on the island to ensure that the birds were not molested and to show visitors points of interest at the Ternery. Besides ourselves the party included Mr. H. W. Richmond, who acted as Watcher for the greater part of the time, and Messrs. H. K. A. Shaw and B. A. Southgate, who helped with the listing of the species and the surveying of the parts not marked on the existing maps. The weather was glorious throughout, and during our stay we were able to watch the young Terns, most of which were nestlings when we arrived, pass through the early stages of their life until, at our departure, they were scarcely distinguishable from the adult birds when in flight.

Scolt Head Island



Sand dunes white ; Exposed shingle black ; Marshes dotted ; Unvegetated mud white.


N
Enclosed Salting
Anchor lateral & marsh
Marsh "B"
Ternery
Marsh "C"
Long Dunes.
BRANCASTER HARBOUR
Golf Course
To Brancaster Staithe

Sand d

Towards the end of July we were visited by Professor F. W. Oliver and some friends from Blakeney Point. From him we gained many helpful suggestions on various aspects of the vegetation. At his invitation, too, we paid a return visit to Blakeney, and were able to make a few comparisons between the two areas, although no detailed study was possible. However, Professor Oliver has himself written a short comparison between Scolt Head and Blakeney Point in these Transactions (Vol. XI., 1924, pp. 565-578).

The Ordnance Survey Maps do not show the oldest laterals, and since the last survey was made in 1904 (published in 1907), the island has changed considerably at the Ternery end, the main bank having increased in length by about five hundred yards, with the formation of several new laterals. The omitted laterals and the recent changes have been introduced in the map given here, although the time and the means at our disposal did not permit any great accuracy in the surveying. It is hoped that a more careful survey will be carried out in the near future.

For convenience we have named outstanding landmarks on the island, using as far as possible descriptive names. Thus Privet Hill is named after the large beacon-like mass of Privet bushes at its seaward end. A small brick hut has given its local name to the " House Hills," and the " Long Dunes " is sufficiently descriptive of the dunes covering the most westerly dune-covered lateral complex. It is at the far end of these dunes that one is landed when ferried over from Brancaster Staithe.

II. Structure

Scolt Head, like Blakeney Point, consists of a shingle spit arising at a small angle from the mainland, and gradually elongating as more shingle is added to the free seaward end. This kind of formation, with the elongation of the main bank and the formation of laterals, has been so thoroughly described by Professor Oliver for Blakeney Point in various papers that we need do no more than mention the ways in which the Scolt Head system differs from that at Blakeney.

The most obvious difference lies in the fact that at Scolt Head

the main bank and many of the laterals are covered with sand-dunes, often of considerable height (sixty feet at the Massif), while at Blakeney Point the dunes are confined to the Headland and the Hood. While, therefore, at Blakeney the bare and unprotected main shingle bank is being driven landwards over the marshes, the main bank at Scolt Head, by virtue of its protecting sand-dunes, is stable. In fact, practically the only place where mobile shingle in any way comparable with that at Blakeney, is found, is at the base of the lateral bearing the Long Dunes, where the shingle bank is freely exposed to gales from the south-west.

As a consequence of the stability of the main bank at Scolt Head, the laterals are longer than at Blakeney, and the marshes between them are of correspondingly greater extent. The laterals themselves are rather more intricately arranged than at Blakeney. Thus there is a large complex of laterals between the Massif and the Long Dune, and another at the House Hills. These places are rendered more difficult of interpretation by being covered with high dunes, so that only the tips of the laterals are exposed. The long laterals of the older parts of the island are much lower than the corresponding ones at the " Marrams " at Blakeney, and rise little above marsh level. Moreover, apart from the large L-shaped lateral at the Burnham end, they are not so well clothed with vegetation, except, perhaps, at their hooked apices.

In many places the shingle has been partially washed away by the sea, and deposited elsewhere. At the small marsh (" End Marsh ") at the Burnham end of the island, there is quite a network of low shingle banks, some of which may have arisen in this way.

The opening of the channel to the sea at Burnham Harbour considerably affects the currents, as the incoming tide enters at this end as well as at Brancaster Harbour. Hence any exposed marsh at the Burnham end will be liable to considerable erosion. This probably accounts for the large area covered by Aster in the marshes at this end. The oldest marshes at Blakeney are not liable to the same forces. Presumably at one time the main shingle bank and the mainland were continuous, the breach being secondary.

The Ordnance Survey Map of 1891* shows that the main bank then ended opposite the Long Dunes, which would therefore be in some ways comparable with the Headland at Blakeney, while the new part corresponds to the Far Point. On the other hand this new part, which has increased in length by over a mile in thirty years, does not seem likely to be washed away. Dunes have formed on it, have in many places reached a relatively stable condition, and have been eroded by wind action in this short time, while the marshes protected by the laterals are well clothed with vegetation.

There are no " lows " at Scolt Head strictly comparable with those at Blakeney. The same type of habitat, however, is present as a result of the complete erosion of the dunes by wind action.

III. Shingle

Exposed shingle is not such a feature at Scolt Head as at Blakeney Point, as the older dunes still cover much of the shingle of the main bank and of the laterals. Such exposed shingle as does exist is generally stable, and once bore dunes which have since been blown away. Except for the small amount of mobile shingle, all the shingle on the island is mixed with a good deal of sand. The flora of the stable shingle is described later (Section VII.), and we will here describe only the flora of the short stretch of mobile shingle situated at the base of the west side of the Long Dunes (N.E. of marsh C. on map). Here there are two stretches of such shingle, each about fifty yards long. They are separated by a few yards of non-mobile shingle, situated in the shelter of a salient in the bank, which protects these few yards from waves striking obliquely on the bank.

The mobile shingle shows the characteristic gradual slope on the seaward side and steep slope on the inner side, and is composed of loose pebbles, an admixture of sand only being encountered at some depth. The shingle is advancing over an expanse of stable shingle, covered with *Limonium binervosum* and associated plants, which bears in some places vestigial dunes a foot or so high. *Suæda fruticosa* accompanied by

* Surveyed 1886; published 1891.

occasional *Obione* and *Limonium reticulatum* forms a zone along the marsh-edge. The roots of the *Suæda* are being uncovered as the shingle is washed inwards. *Suæda* bushes also occur on the inside of the mobile shingle stretches, and where it is present in large quantities, the advance of the shingle is checked appreciably by it. (See Oliver and Salisbury, Journ. Ecol. I., 1913, pp. 249-272).

The chief other plants are :—

Arenaria peploides	a
Rumex trigranulatus	f - a
Silene maritima	f

These are all found along the drift line in other parts of the island, but here, especially in the case of *Silene maritima*, they tend rather to rank growth.

In the southern section the shingle is heaped up three to four feet above the level of the shingle behind, but in the northern stretch it is only about a foot above it, and more sand is mixed with the pebbles. Evidently this part is not so actively mobile as the southern part, and in consequence, the numbers of plants are greater. In this northern stretch *Arenaria peploides* is especially abundant, and the following also occur :—

Arenaria serpyllifolia	f
Senecio vulgaris *Senecio Jacobæa* *Sedum acre* *Sonchus asper*	a few plants.

In the southern stretch are a few plants of *Limonium binervosum* and *Obione*.

It will be seen that although the expanse of mobile shingle is nothing like as great as at Blakeney, yet the typical plants are the same. Of plants absent from Scolt Head, but occuring elsewhere in this type of habitat, the most noticeable are *Glaucium luteum*, which is such a feature of the main bank at Blakeney, and *Anagallis arvensis*, also found at Blakeney ; and, of course, there is no *Mertensia*.

IV. The Drift Line

The drift line is found at the highest tide mark. A line of débris of plant remains and rabbit pellets is found here, often of

considerable depth, especially in the older and more thickly plant-covered marshes. This acts as a manure and also as a mulch, so that this line is moister than the dunes behind, but considerably drier than the marsh, being covered by the sea only at the highest tides. With the débris are cast up many seeds, rhizomes, and other viable parts of plants, which may establish themselves here, so that a heterogeneous collection of plants is found, consisting, however, chiefly of those plants whose seeds are normally transported by the sea. Therefore it is not surprising if some typical marsh plants occur locally, such as *Obione* and *Suæda maritima*, although the habitat is too dry for most of them. Seeds may also possibly be carried in the abundant rabbit pellets, and the débris will catch any other seeds which may drop or be blown on to it. This last fact probably accounts for the local abundance of *Senecio vulgaris*, *S. sylvaticus*, *Sonchus asper* and *S. oleraceus*.

The plants of the drift line, other than those mentioned above, may be divided into three groups.

(*a*) *Plants Characteristic of the drift line, and rarely found elsewhere* :—

Artemisia maritima—older parts especially. The position of this plant is probably determined chiefly by moisture relations. It is characteristic of the dune-ward edge of the "general salt-marsh association," although often found on sandy shingle.

Atriplex littoralis.

,, *hastata* (var.)

,, *patula* (var.)

Cakile maritima—only abundant at the Ternery end.

Cochlearia danica—older parts.

Polygonum aviculare (agg.)—only frequent at Ternery end.

Salsola kali—perhaps the most generally distributed drift-line plant.

Suæda fruticosa—the most abundant drift-line plant on the marsh side.

Agropyron junceum—only abundant at Ternery end.

,, *pungens*—older parts : grows in much the same situations as *Artemisia maritima*.

(*b*) *Plants characteristic of other habitats*, but which, having seeds normally or occasionally carried by the sea, are also frequent on the drift line. These are given with their more normal positions :—

Statice (*Armeria*) *maritima*
Frankenia lævis
Limonium binervosum
} Stable shingle.

Plantago coronopus—stable shingle and stable dunes.
Limonium reticulatum—sandy shingle and marsh.

Arenaria peploides
Silene maritima
Rumex trigranulatus
} More or less mobile shingle.

Festuca rubra is also found in the drift line of older parts.

(*c*) *Casuals and rare species* of the drift line. These may or may not establish themselves on the island :—

Beta maritima—two plants.
Chenopodium album—a few very dwarfed plants.
Euphorbia paralias—this is perhaps best mentioned here. There is one very large patch extending over a low dune on the side facing a bay.
Œnothera sp.—one plant (? now pulled up).
Raphanus raphanistrum—one plant.
Solanum nigrum—one plant.
Urtica dioica—one patch.

On the seaward face of the main bank the drift flora is small, the only plants being *Salsola*, and a little *Cakile* and *Agropyron junceum*. These, moreover, only occur in any quantity along the western half of the island.

The youngest laterals at the Ternery end of the island are little more than a drift flora. The most conspicuous plants are *Cakile maritima* and *Salsola kali*, but quite as abundant are young plants of *Agropyron junceum*, the starting-points of embryo dunes.

V. Dunes

(a) The "Yellow Dune" Stage.—Embryo dunes are well seen at the Ternery end of the island, where the successive stages in dune formation and maturation are seen as one passes eastwards. Dune formation begins with the plants of

Agropyron junceum at the drift line. These catch the blown sand and form hummocks. Where the sea can rarely cover it *Ammophila* occurs, and further back the summits of all the dune-hummocks are covered with this grass. The hummocks now link up into ridges both at right angles to and parallel with the direction of the main bank, with *Ammophila* on the crests, and *Agropyron* in the hollows. Later a continuous dune system is formed. At this stage *Festuca rubra* also occurs in some quantity. Other plants found in the embryo dunes are *Arenaria peploides* which often forms hummocks on its own, and *Elymus arenarius*. *Elymus* is sparsely distributed over all the mobile dunes, but rarely flowers on the island, and is never of much importance in dune formation here.

The belt of dunes from the Ternery to the Massif is in a mobile condition, and *Eryngium* is here very conspicuous. *Agropyron junceum* soon dies out and is replaced by *Festuca rubra*, but *Arenaria peploides* persists.

The chief other plants are ephemerals. It is interesting in this connection that *Cakile* grows as an ephemeral on these young dunes. *Senecio vulgaris* is abundant near the Watcher's Hut. The hollows are colonised by *Sedum acre* and the moss *Bryum cæspiticium*, which cake the surface layers and tend to hinder erosion by wind. Except for a few lichen-covered hummocks, where *Erodium cicutarium*, a few Composites, etc. may be found, no other plants occur on these dunes until one gets near the Massif.

This part of the main bank is very recent, being only forty years old at most, since it is not marked in the Ordnance Survey of 1886 (map published, 1891). Thus in this short time dunes have been formed, stabilised (at least in parts, as is shown by the hummocks bearing a vegetation characteristic of more stable dunes), and broken up again by wind action—helped doubtless by rabbits, whose pellets are found all over these parts as well as the rest of the dune system, although in the unstable dunes their burrows are less frequent.

On the main bank opposite the Long Dunes, other plants occur. *Calystegia soldanella* is abundant, as is *Lotus corniculatus*. *Carex arenaria* comes in suddenly in great quantity at the break in the main line of dunes just west of the Massif.

From here eastwards, the dunes have a closed vegetation, and are for the most part high and stable, only broken at occasional places where erosion has occurred.

(*b*) *Older Dunes* ("Grey Dune" Stage).—The Massif. As one passes from these low dune systems to the group of high dunes that constitute the Massif, one cannot fail to notice the great and sudden change in the character of the vegetation. Where, before, it was fairly open, it now becomes quite closed except for places where active erosion is taking place.

The sides of the dunes are still thickly covered with *Ammophila*. In the hollows, however, the *Ammophila* tends to become scanty, its place being taken by *Carex arenaria*, often much nibbled by rabbits. There are also frequent patches of *Festuca rubra*. Close to the soil surface is an almost continuous covering of mosses, *Hypnum cupressiforme* being by far the commonest, though *Tortula ruraliformis* is abundant on partially bared areas.

Several of the species occurring on the young dunes are not found on older dunes like the Massif. The most obvious examples of such are *Eryngium maritimum* and *Arenaria peploides*, with the moss *Bryum cæspiticium*, which is now very rare. The flora of the Massif, nevertheless, is very much richer than that of the younger dunes. The most abundant species are *Senecio jacobæa*, *Cynoglossum officinale*, *Erodium cicutarium*, *Lotus corniculatus*, *Viola riviniana*, *Galium verum* (which rarely flowers on the Massif), *Cirsium lanceolatum*, *C. arvense*, *Veronica chamædrys*, *Leontodon nudicaulis*, *L. autumnalis*. *Polypodium vulgare* is locally abundant, and there are several plants of the Male Fern.

Ephemerals occur here, as on the younger dunes, but *Veronica arvensis* is an addition. The other ephemerals are *Aira præcox*, *A. caryophyllea*, *Arenaria serpyllifolia*, *Cerastium semidecandrum*, *C. tetrandrum*, *Myosotis collina*, *Phleum arenarium*, *Stellaria boræana*, *Valerianella olitoria*.

In hollows and dips covered with *Ammophila* many rarer species occur. Other grasses, especially *Agrostis alba* and *A. tenuis*, with *Poa pratensis* and *Holcus lanatus*, form an undergrowth. Masses of the moss *Hylocomium triquetrum* occur in the most sheltered parts. *Geranium molle*, *Carlina vulgaris*

and other thistles are commoner here than elsewhere, and *Campanula rotundifolia, Peucedanum sativum, Arctium lappa, Cerastium vulgare* and *C. viscosum* are found in some of the hollows.

Other plants of note on the Massif are *Orchis pyramidalis, Rubus sp., Rosa sp., Ligustrum vulgare, Sambucus nigra, Ribes grossularia, Luzula campestris* and *Festuca rigida. Corynephorus*, which is so abundant on the Hood at Blakeney, has so far not been found at Scolt Head.

In hollows at the western end of the Massif there are many lichens, chiefly species of *Cladonia* and *Peltigera*, and the vegetation has somewhat the appearance of that of the House Hills, to be described later.

Privet Hill. East of the Massif system, and about seven hundred yards from the Hut, is a slight bend in the coast, where there are only a few embryonic dune hummocks on a stretch of sandy shingle. Presumably the gap in the main dune system has been caused by wind and heavy seas. That the sea has broken right through is shown by the large shingle fan on the marsh side. Opposite the west end of this gap is an isolated lateral dune—Privet Hill—whose flora is much like that of the Massif. Of interest are the large masses of privet, and the extensive stretches of stable shingle both at its seaward and landward ends. These are doubtless the sites of dunes which have been completely destroyed by natural agencies.

House Hills. Further east, and parallel with the Privet Hill, is a large lateral system known as House Hills. These dunes are in a rather older stage than those of the Massif, and the hollows are much more extensive, so that the flora of the Massif hollows is here found over a large area. Here there is very little *Ammophila*, and especially conspicuous are lichens, which in summer, when they are dry, crackle under the feet in a characteristic manner. Mosses are abundant, *Hypnum cupressiforme* being the commonest, while tufts of *Dicranum scoparium* are frequent. The most abundant plants of the turf are *Carex arenaria, Holcus lanatus, Galium verum, Lotus corniculatus*, and *Rumex acetosella*, with ephemerals such as *Aira præcox*; also *Agrostis tenuis* and *A. alba, Erodium cicutarium, Leontodon nudicaulis, Hypochæris glabra* and *H. radicata, Koeleria cristata*,

and *Poa pratensis*. Several plants of *Aspidium filix-mas* occur, chiefly in old rabbit burrows.

In some parts, where the lichens and mosses are especially thick, the *Carex* is not so luxuriant, though still abundant. *Rumex acetosella* and *Plantago coronopus* are very common, and frequent are *Agrostis, Holcus, Sedum acre, Galium verum* and ephemerals.

In one of the hollows a trench has been dug. This is filled with brackish water, and round it many young trees have been planted with the object of providing a resting-place for migrating Passeres. These trees are in a rabbit-proof enclosure where *Carex* and the other dune plants grow taller. Round the trench are found *Stellaria graminea, Trifolium repens, Prunella vulgaris, Cerastium vulgare, Veronica chamædrys, Lotus corniculatus, Agrostis spp., Cirsium arvense, Sagina procumbens*. At the edge of the brackish water occur plants of *Salicornia* (annual), *Suæda maritima* and *Glaux maritima*.

Around the enclosure is a large quantity of *Campanula rotundifolia*.

On the sides of the dunes *Ammophila* persists, *Carex* being subdominant and *Festuca* locally abundant, whilst the almost ubiquitous *Senecio jacobæa* and *Cynoglossum officinale* stand up with *Lactuca virosa* above the general level of the vegetation. At the southern end of the House Hills are several plants of Rose, Elder, Privet, White Bryony, Bittersweet and Bramble. All these have succulent fruits, suggesting that they have been introduced by birds.

The Main Line of Dunes, Eastern Portion.—Proceeding eastwards from the junction of the House Hills with the main dune system, one reaches a long belt of dunes in the "yellow" stage, rather sparsely covered with vegetation. Here *Eryngium* and *Arenaria peploides* re-apper in large quantity, and one is given the impression that the dunes have been broken through in places by the sea, and are in a mobile stage after regeneration. That they are not actually young is shown by the occurrence of Male Fern and several composites characteristic of older dunes. They thus resemble the mobile dune-system from the Massif westward to the Ternery, which also includes remnants of older dunes. *Erigeron canadensis* occurs here, and there is

a fair amount of *Suæda fruticosa*, suggesting that the dunes at this point have been blown over the marsh and bared laterals, and that this typical shingle plant has grown up through the sand.

About halfway along from House Hills to End Marsh the dunes begin to widen out, and become considerably higher again, the vegetation resembling that of the Massif and House Hills. Thus in the hollows *Ammophila* is confined to occasional patches, *Carex arenaria* and *Festuca* becoming the dominants. *Galium verum* flowers abundantly here and forms large patches, as does *Lotus corniculatus*. Other plants present on the Massif occur, while there is a much thicker covering of mosses and lichens. Privet, Hawthorn, Elder, Bramble, and occasionally Bryony are found, and *Lactuca virosa* and *Cynoglossum officinale* are common. In July and August the dune-hollows blaze with flowering composites—species of *Hypochæris*, *Senecio*, *Leontodon*, *Taraxacum*, *Sonchus* (chiefly *S. asper*), *Hieracium pilosella*, *Crepis capillaris*, *Tragopogon minus* and *Erigeron acris*. *Polypodium vulgare* is quite common, its fronds emerging in characteristic fashion from the bases of the *Ammophila* clumps. There are occasional large patches of *Clinopodium vulgare* and *Viola tricolor* (agg.). The Bee Orchis also occurs. In the Spring many ephemerals flower, as on the younger dunes.

At the western end of this stretch of dunes there is a large hollow with a very interesting flora. Here a hole has been dug, and the level of the brackish water is only a foot below the surface of the ground. In it grows *Ranunculus baudotii*, together with green algæ such as *Spirogyra* and *Zygnema*, and rotifers. Round the holes and in large patches elsewhere, there is much *Juncus maritimus* with some *J. gerardi*. *Festuca rubra*, *Carex arenaria* and *Agrostis* dominate the remainder of the hollow, while quite a number of species usually found in damp meadows occur, as, for example, *Prunella vulgaris*, *Pulicaria dysenterica*, *Epilobium tetragonum* (var.), *Juncus articulatus*, *Vicia angustifolia*, *Holcus lanatus*, *Bellis perennis*, and *Potentilla anserina*. With the *Juncus maritimus* are found *Epipactis palustris*, *Listera ovata*, *Sonchus arvensis*. The ground is carpeted with mosses, among which grow lichens, *Sedum acre*, *Trifolium*

dubium, and *Sagina spp.* There are also some other typical dune plants and a large patch of Privet.

The vegetation of this low-lying part of the old dunes is thus in many respects like that of an ordinary damp meadow, and one might expect to find drinkable water on some of the dunes, as has been the case at Blakeney. The hole was, in fact, dug in this hope, but unfortunately, like the water on House Hills, it is distinctly brackish.

The Long Dunes ; Hut Lateral.—So far only two of the lateral dunes have been mentioned—Privet Hill and House Hills. The only others of any size are the Long Dunes, and the dune on Hut Lateral. These are in a rather younger condition than the more eastern dunes, but have the widely distributed Bramble and also *Ononis repens* (the spiny variety). They are much infested with rabbits, and show features of denudation at their landward and seaward ends, just as is the case with Privet Hill.

VI. Marshes

The earliest stages in marsh formation are well seen at the western end of the island. The marshes, as at Blakeney, are graded according to age, those at the western end being youngest and those at the eastern end the oldest. This sequence holds in the main, but in a few parts, such as the large Aster marsh near Burnham Harbour, it is altered by erosion of the marsh land.

The large bay west of the Long Dunes is covered with muddy shingle on which *Zostera nana* grows abundantly. This may be considered to be the first stage in some successions. Nearer the main bank, however, and especially in the protecting arms of the laterals, the bays become silted up with mud and sand in varying proportions. In the youngest parts of Scolt Head the mud generally predominates, and the first vegetation is a sparse covering of annual *Salicornia*. Where the soil is largely composed of sand, as, for example, in the space between the two laterals opposite the Watchers' Hut at the Ternery, the pioneer is *Suæda maritima*, not *Salicornia*. A curious phenomenon on the sparsely covered mud is the thick vegetation occurring in foot-marks and cart-tracks there. Much

seed is caught in these and the result is a line of patches of *Salicornia* or *Suæda maritima* crossing the otherwise bare mud. The seeds of *Suæda fruticosa* and *Limonium reticulatum* are caught in a similar manner in other parts of the island.

Silting is most rapid in the protecting arms of the laterals, and here the first marshes occur. The vegetation becomes thicker until there is a dense sward of annual *Salicornia* often with *Salicornia perennis*. Generally the *Salicornia* at this stage is associated with the marsh forms of the brown algæ *Pelvetia canaliculata* and *Fucus vesiculosus*, and with the red marsh alga *Bostrychia scorpioides*.

From this initial stage there are several types of succession. The first type is seen in an early stage in the Anchor Marsh, marsh B between two laterals, and marsh C at the mouth of the creek leading to the enclosed salting. These marshes show the Salicornia sward being invaded by *Suæda maritima* followed by *Obione*. *Limonium vulgare* is frequent, chiefly in the *Suæda* and *Obione* zones, while *Glyceria maritima*, *Spergularia media*, and rarely *Limonium reticulatum* occur. The zonation is beautifully shown in the small Anchor Marsh. The soil here is mud with a little sand. Marsh formation has been very rapid. Forty years ago the main bank stopped at the base of the Long Dunes, and it will be seen from the map that the Anchor lateral is six hundred yards further on. Prof. Oliver states that this marsh was a pure Salicornia stand in 1915.

On the stiff mud by Norton Creek the succession is different. *Salicornia* is the pioneer, and there is much *Pelvetia* and *Bostrychia*. The next colonists are *Aster tripolium* (chiefly rayless) and *Suæda maritima* var. *flexilis*. After this comes *Limonium vulgare* and often the marsh becomes an almost pure stretch of Sea Lavender. Such parts, which are strikingly beautiful in the beginning of August, are a feature round the House Hills. *Limonium humile*, which hybridises readily with *L. vulgare*, is frequent in the outer parts of the marshes between House Hills and the Long Dunes. Occasional luxuriant patches of *Triglochin maritimum*, *Glyceria* and *Spergularia* occur. A rank growth of Obione forms a zone along the edges of the creeks and ultimately spreads over the marsh, smothering the other halophytes. The final stage is seen in the outer

stretches of marsh bordering the Creek, where there is generally an almost pure growth of tall Obione, with occasional tall Aster, *Suæda maritima* and *Salicornia perennis*, and rarely a few other halophytes. This is the stage of the older marshes of the Marrams at Blakeney. Perhaps the main bank has advanced over the inner parts of the marshes there and the only part remaining is this outer *Obione* portion.

The inner part of the marshes between the House Hills and Long Dunes is pure sand with a very thin layer of mud over the surface. The flora is very different from that of the mud near the Creek, and the two parts are sharply separated by a zone of sandy mud, generally almost completely bare of vegetation.

The inner sandy part is covered with a turf of *Obione*, which is small leaved in all these sandy marshes, and is probably forma *parvifolia*. The plants here are :—

Atriplex (*Obione*) *portulacoides*	a
Salicornia (dwarf annual species)	a
S. perennis	f
Suæda maritima	o - f
Glyceria maritima	o - f
Limonium reticulatum	o - f
L. vulgare	o
Spergularia media	o

The *Obione* and *Limonium reticulatum* are the most conspicuous plants.

On the sandy mud freshly deposited at the inner bends of the creeks in this part the flora consists of :—

Salicornia (annual)	a
S. perennis	o
Suæda maritima	f (especially at margins of creeks).
Obione	o
Limonium reticulatum	o
L. vulgare	o
Glyceria maritima	o
Spergularia media	o

The enclosed salting is in some parts similar. It is a curious structure lying in the base of the complex of laterals bearing

the Long Dunes. A long winding channel connects it with the sea at C, and divides it longitudinally into two parts. The soil is mud with a small admixture of sand. The eastern half consists of tall *Limonium vulgare* more or less pure, but with occasional *Obione*. The *Limonium* is very badly attacked by rust (*Uromyces limonii*) and mildew (*Erysiphe*). The latter does most damage, and often all the leaves are shrivelled. This is the most diseased patch of Sea Lavender on the island, although both fungi are well distributed over the other marshes. In the western half there is a turf of *Glyceria* (small, more or less separated plants) *Obione* (*parvifolia*), dwarf annual Salicornias, *S. perennis*, and a few small *Suæda maritima* plants. *Limonium reticulatum* is abundant, its inflorescences forming part of the turf, and a short form of *L. vulgare* is frequent. In the lower, wetter, parts is a turf of *Glyceria* and *Salicornia* (annual), with *Obione*, *Limonium reticulatum* and *L. vulgare* entering as young plants.

The north-west corner resembles closely the Hut Marsh.

Older Marshes.—These lie between the laterals east of House Hills. "End Marsh" is similar. They are of the mixed salting type, with luxuriant halophytes. The plants here are *Limonium vulgare*, tending towards forma *pyramidale*, *Plantago maritima*, *Glyceria*, *Obione*, and *Spergularia media* in about equal proportions. The *Obione* does not seem to be over running the marsh, as it does in the outer stiff mud by the river.

The edge of these marshes is higher and considerably less often covered by the sea. It bears a distinct flora which is seen very clearly all along the marshes from House Hills to Burnham. There is a short turf of—

Statice (*Armeria*) *maritima*	a
Plantago maritima	a
Glyceria maritima	a
Spergularia media	a
Limonium vulgare	o - f
Salicornia (dwarf species, incl. *S. perennis*)	o

At the edge of the Aster marsh this formation is very clearly seen, and is backed by a belt of *Juncus maritimus*. In the *Armeria* turf along this stretch *Juncus gerardi* occurs frequently,

and there is also a species of *Carex*, specimens of which were unfortunately lost.

The Great Aster Marsh.—It will be seen from its position on the map, that while the marshes on either side are well protected by their long L-shaped laterals, this part is completely exposed to the eroding action of the tide. The limit of the eroded area is marked by a sharp drop of nearly a foot from the Armeria turf to the Aster marsh. This corresponds pretty closely with the H.W.M.O.T. of the Ordnance Map (1907).

The mud is very soft and bears a sparse vegetation consisting of little else than Salicornia and Aster. The marsh algæ, of which Fucus is the most common, are only abundant in parts, chiefly near the Channel. Three patches of *Spartina stricta* were found here.

The general characteristics of the vegetation thus fit in with the view that the marsh has been rejuvenated by erosion, this being most probably due to the breach of the main bank at Burnham Harbour.

At the inner edge of the old marshes half way to Burnham Harbour from the House Hills extends a curious zone of luxuriant halophytes. The main line of dunes, as previously mentioned, has here been broken down, and they are now in a more or less mobile condition. At the edge of the dune on the marsh side is a zone of *Agropyron pungens*, with *Artemisia maritima*, *Festuca rubra*, *Obione*, *Frankenia*, etc. Along here, too, are large patches of *Elymus*, which, as elsewhere on the island, rarely flowers. The most interesting point about this part, however, is the large quantity of *Limonium vulgare* f. *pyramidale* in its most extreme form, with enormous trusses of flowers. Other halophytes in the same locality are *Plantago maritima* (including var. *latifolia*), and *Spergularia media*. All are very luxuriant. These plants are growing in pure sand which is covered by the sea only nine times a month at most. The sand was pure as far down as we dug—two feet—and only root-stock portions of the plants had been exposed at that depth. The Plantago especially showed several marks of former crowns at intervals of one or two inches along the stock so uncovered, so that sand had apparently buried the plant several times.

It has already been suggested from other considerations (p. 97) that the dunes have encroached somewhat on the marsh. (In this connection compare De Fraine, A.B., 1916, pp. 242, 243, Effect on *Limonium binervosum* of covering with shingle.) For most of the rest of the way to Burnham along the inside of the marsh is a zone of *Juncus maritimus*. In this grow *Artemisia, Glaux, Limonium vulgare*, forma *pyramidale*, and *Plantago maritima*.

Behind this zone, in the Festuca belt, *Lepturus filiformis* grows very luxuriantly.

VII. Erosion of Dunes

In many parts of the island the Dunes show evidence of erosion by wind, helped in most cases by the abundant rabbits which bare the surface of the sand by scratching and burrowing and by close nibbling of the vegetation.

Extensive blow-outs occur on the Massif, the Long Hills, the House Hills, and elsewhere. The older dunes at the Burnham end, which have a somewhat better plant covering, do not show evidence of any very recent ones. If the blow-out is in the middle of a large dune-system, it often becomes covered with vegetation again, and forms a sheltered hollow in which the rarer, more mesophytic, plants may be found. the steep-sided basin-shaped hollows in most of the dunes probably originated in this way.

If a blow-out extends quite across a dune-system, however, as is very likely to occur on the narrower lateral systems, two vertical faces of bare sand are exposed to the wind, and the whole dune system may be eaten away down to the shingle. Breaks in the main line of dunes occur just east and west of the Massif, the latter being of considerable extent. The breaking may not be completed, however, as the dune may be regenerated. Dunes secondarily in the mobile or " yellow " stage through rejuvenation are seen in the main system between House Hills and the old high dunes at the Burnham end, and between the Massif and the Ternery. Nearer the Ternery, however, the dunes are primarily "yellow,"and it is to be expected that they will pass through the stages of the succession to stable dunes.

The complete erosion of dunes is beautifully demonstrated in all its stages in the Long Dunes. The earliest stages are seen at the far end, while at the near end only vestigial sand-heaps, often retaining a somewhat sparse covering of mosses, lichens and ephemerals, but showing no perennial phanerogams, are seen. The chief mosses in such places are *Tortula ruraliformis* and *Camptothecium lutescens*. On the recently-bared sandy shingle the mosses *Tortula ruraliformis* and *Ceratodon purpureus* are the most abundant plants

The bared shingle is covered by the sea at the highest tides—about five times a month, so far as we were able to judge. It is possible, however, that spring tides sufficiently high to cover all such shingle may not occur for several months on end.

The shingle at the near end of the Long Dunes is thickly covered with *Limonium binervosum*, which forms a sheet of deep lavender in late July. The flora of the shingle is more or less the same, both in this part and at the two ends of the House Hills, but in the latter place *Limonium binervosum* is not quite so abundant. On the other hand, at the base of Privet Hill and House Hills the laterals are narrower, and the zonation of the plants at different levels is very clearly seen.

The lowest zone consists of *Suæda fruticosa* bushes with abundant *Limonium reticulatum*, and with many marsh plants, such as *Obione*, *Glyceria*, dwarf *Salicornia* and *Suæda maritima*. The pebbles are covered with black lichens (*Lecanora spp.*).

The next higher zone contains *Limonium binervosum* and *Frankenia lævis*, with a little *Limonium reticulatum*. Other lichens besides those occurring at the lowest levels are now found, including *Xanthoria*, which becomes even more abundant in the next zone.

The crests of the laterals are thickly covered with *Limonium binervosum*, *Statice maritima* being common and *Frankenia lævis* occasional. At the near end of the Long Dunes, *Plantago coronopus* forma *pygmæa* is abundant. The pebbles are thickly covered with lichens, especially near the House Hills. *Limonium binervosum* extends up the dunes to the drift-line, and relict dunes are covered with it if reached by high tides.

It will be seen that the flora of these shingle stretches is

very much like that of the "lows" at Blakeney, although there is no evidence that at Scolt Head such areas have been produced through the formation of apposition banks.

The older laterals east of the House Hills have a covering of grasses at least over their far ends, which are often hooked. On the shingle at the end of the House Hills *Agrostis alba* (var. ? *maritima*) occurs in patches. On the still older laterals, however, *Agropyron pungens* and *Festuca rubra*, which separately or together form a close turf, are more common. On the hooks of the laterals just east of the House Hills, lichens such as *Cladonia* are abundant, with *Plantago coronopus* and some other plants. The vegetation here rather resembles the lichen formation on the dunes.

VIII

This is only a very general account of the flora of Scolt Head Island, but it will be seen that a vast number of interesting problems arise with regard to the various plant communities and their succession. It is hoped that some of these may be attacked in the near future.

The work was carried out under the general direction of Dr. H. Hamshaw Thomas, whom we wish to thank for helpful suggestions.

In conclusion we wish to express our hearty thanks to the Norfolk and Norwich Naturalists' Society, and to the Honorary Secretary, Dr. S. H. Long, for their kindness in allowing us the use of the Hut and for their hospitality during our most enjoyable stay on the island.

List of Flowering Plants and Ferns

Ranunculaceæ.

Ranunculus repens *L.*
Ranunculus baudotii *Godr.* var. confusus (*Godr.*)

Cruciferæ.

Erophila verna *Mey.*
Cochlearia danica *L.*
Cochlearia anglica *L.* (to be verified).
Cakile maritima *Scop.*
Raphanus raphanistrum *L.*

VIOLACEÆ.

Viola riviniana *Reichb.* (to be verified).
Viola tricolor *L.* (agg.—to be determined).

FRANKENIACEÆ.

Frankenia lævis *L.*

CARYOPHYLLACEÆ.

Silene maritima *With.*
Cerastium vulgatum *L.*
Cerastium viscosum *L.*
Cerastium tetrandrum *Curt.*
Cerastium semidecandrum *L.*
Stellaria media *Vill.*
Stellaria media. Var. boræana *Jord.*
Stellaria graminea *L.*
Arenaria serpyllifolia *L.*
Arenaria peploides *L.*
Sagina nodosa *Fenzl.*
Sagina apetala *Ard.*
Sagina maritima *Don.*
Sagina procumbens *L.*
Spergularia media *Presl.* (S. marginata *Kittel*).

GERANIACEÆ.

Geranium molle *L.*
Erodium cicutarium *L'Her.*

LEGUMINOSÆ.

Ononis repens *L.* var. horrida *Lange.*
Trifolium repens *L.*
Trifolium dubium *Sibth.*
Lotus corniculatus *L.* (? var. crassifolius *Pers*).
Vicia angustifolia *L.*

ROSACEÆ.

Rubus sp.
Potentilla anserina *L.*
Rosa sp.
Cratægus monogyna *Jacq.*

SAXIFRAGACEÆ.

Ribes uva-crispa *L.* var. grossularia *L.*

CRASSULACEÆ.

Sedum acre *L.*

ONAGRACEÆ.

Epilobium tetragonum *L.* (to be verified).
Œnothera sp. (Red flrs.; club-shaped fruit; ? up-rooted later.)

CUCURBITACEÆ.

Bryonia dioica *Jacq.*

UMBELLIFERÆ.

Eryngium maritimum *L.*
Anthriscus scandix *Beck.* (A. vulgaris *Bernh.*)
Peucedanum sativum *Benth. and Hook.*
Daucus carota *L.*

CAPRIFOLIACEÆ.

Sambucus nigra *L.*

RUBIACEÆ.

Galium verum *L.* (? var. maritimum *Dc.*)

VALERIANACEÆ.

Valerianella olitoria *Poll.*

COMPOSITÆ.

Bellis perennis *L.*
Aster tripolium *L.*
Aster tripolium. var. discoideus *Reichb.*
Erigeron acris *L.*
Erigeron canadensis *L.*
Pulicaria dysenterica *Gray.*
Matricaria inodora *L.*
Artemisia maritima *L.*
Artemisia maritima. var. gallica *Willd.* probably occurs.
Senecio jacobæa *L.*
Senecio sylvaticus *L.*
Senecio vulgaris *L.*

COMPOSITÆ (*continued*).

Carlina vulgaris *L.*
Arctium lappa *L.*
Carduus nutans *L.*
Cirsium lanceolatum *Scop.*
Cirsium arvense *Scop.*
Hieracium pilosella *L.* agg.
Crepis capillaris *Wallr.* (C. virens *L.*)
Hypochæris radicata *L.*
Hypochæris glabra *L.*
Leontodon autumnalis *L.*
Leontodon nudicaulis *Banks.* (Thrincia hirta *Roth*).
Leontodon nudicaulis var. lasiolena *Druce.*
Taraxacum vulgare *Lam.* (other species to be determined).
Lactuca virosa *L.*
Sonchus arvensis *L.*
Sonchus asper *Hill.*
Sonchus oleraceus *L.*
Tragopogon pratensis *L.* var. minus *Mill.*

CAMPANULACEÆ.

Campanula rotundifolia *L.*

PLUMBAGINACEÆ.

Limonium vulgare *Mill.* (Statice Limonium *L.*) and forms to pyramidale *Druce.*
Limonium vulgare × humile.
Limonium humile *Mill.* (St. bahusiensis *Fr.*)
Limonium reticulatum *Mill.*
Limonium binervosum *Salm.*
Statice maritima *Mill.* (Armeria vulgaris *Willd.*)

PRIMULACEÆ.

Glaux maritima *L.*

OLEACEÆ.

Ligustrum vulgare *L.*

BORAGINACEÆ.

Cynoglossum officinale *L.*
Myosotis collina *Hoffm.*

CONVOLVULACEÆ.

Calystegia soldanella *Br.*
Convolvulus arvensis *L.*

SOLANACEÆ.

Solanum dulcamara *L.*
Solanum nigrum *L.*

SCROPHULARIACEÆ.

Veronica chamædrys *L.*
Veronica arvensis *L.*

LABIATÆ.

Satureia vulgaris *Fritsch.* (Clinopodium vulgare *L.*)
Prunella vulgaris *L.*

PLANTAGINACEÆ.

Plantago coronopus *L.*
Plantago coronopus forma pygmæa *Lange.*
Plantago maritima *L.*
Plantago maritima. var. latifolia *Syme.*

CHENOPODIACEÆ.

Chenopodium album *L.*
Beta maritima *L.*
Atriplex littoralis *L.*
Atriplex portulacoides *L.* (Obione portulacoides).
Atrplex portulacoides forma parrifolia *Moss.*
Salicornia perennis *Mill.*
Salicornia dolichostachya *Moss.*
Salicornia europæa *L.* agg. (to be determined).
Suæda fruticosa *Forsk.*
Suæda maritima *Dum.* var. macrocarpa *Moq.*
Suæda maritima. var. flexilis *Rouy.*
Salsola kali *L.*

POLYGONACEÆ.

Polygonum convolvulus *L.*
Polygonum aviculare *L.* agg.
Rumex crispus *L.* var. trigranulatus *Syme.*
Rumex acetosella *L.*

EUPHORBIACEÆ.

Euphorbia paralias *L.*

URTICACEÆ.

Urtica dioica *L.*

ORCHIDACEÆ.

Listera ovata *Br.*
Helleborine palustris *Schrank* (Epipactis palustris *Sw.*)
Orchis pyramidalis *L.*
Ophrys apifera *Huds.*

JUNCACEÆ.

Juncus maritimus *Lam.*
Juncus articulatus *L.* (J. lampocarpus *Ehrh.*)
Juncus compressus *Jacq.* var. gerardi *Lois.*
Luzula campestris *Dc.*

NAIADACEÆ.

Triglochin maritimum *Lam.*
Zostera nana *Roth.*

CYPERACEÆ.

Carex arenaria *L.*
Carex sp. (? C. flava *L.*)

GRAMINEÆ.

Spartina stricta *Roth.*
Phleum arenarium *L.*
Agrostis alba *L.*
Agrostis alba. ? var. maritima *Meyer.*
Agrostis tenuis *Sibth.*
Ammophila arenaria *Link.*
Aira caryophyllea *L.*
Aira præcox *L.*
Holcus lanatus *L.*
Koeleria gracilis *Pers.* (K. cristata *auct. br.* p.p.) agg.
Poa annua *L.*
Poa pratensis *L.*
Glyceria maritima *Wahl.*

GRAMINEÆ (*continued*).

Desmazeria loliacea *Nym.* (Festuca rotboellioides *nth.*)
Festuca rigida *Kunth.* (Sclerochloa rigida *Link.*)
Festuca rubra *L.* agg.
Festuca ovina *L.*
Bromus hordeaceus *L.*
Agropyron junceum *Beauv.*
Agropyron pungens *R.* and *S.*
Agropyron pungens. var. littorale *Reichb.*
Agropyron repen *Beauv.* (to be verified).
Lepturus filiformis *Trin.*
Elymus arenarius *L.*

FILICALES.

Asplenium adiantum-nigrum *L.*
Dryopteris filix-mas *Schott.*
Polypodium vulgare *L.*
Phyllitis scolopendium *Newn.* (Scolopendium vulgare *Symons*) has been reported, and should be looked for at the Burnham end.

XI

THE NORWICH CORPORATION SWANHERD'S RETURN FOR 1925

BY SYDNEY H. LONG, M.D., F.Z.S.

IT is probably known to but a few that the Corporation of Norwich still employs a Swanherd, whose duty it is to render annually an account of the nests and cygnets which he finds each season on the waters over which the Corporation and the Trustees of St. Helen's (the Great) Hospital have swan rights. The boundaries of these are Hardley Cross on the river Yare and Hellesdon Mills on the Wensum. But there are certain landowners with swan rights for whom the swanherd also acts, and in his annual report are included the numbers of eggs

and cygnets belonging to these different owners. For this reason his records embrace that section of the Wensum between Hellesdon Mills and Lyng Mills—his boundary.

The Swanherd usually starts looking for nests at the end of April, and two months later—on June 22nd in 1925—begins to start counting the cygnets.

The statutory date for swan upping on the river Yare is the third Monday in August and, on the Wensum, the last Monday. Before these dates no swans may be removed from these waters respectively. The Mayor of Norwich, attended by officials and other interested gentlemen, used at one time always to attend the swan upping on the Yare, but since the mayoralty of Mr. Walter Rye, in 1910, this ancient custom has fallen into abeyance.

At swan upping the cygnets are caught and handed over to their rightful owners, except such as may be required to be left for stock; these latter are marked with the owner's mark, pinioned and released. Where there is an unequal number of cygnets in a brood the Swanherd allocates these to the owners of the parent birds, giving preference to the owner of the cob, or male bird. In the case of the cygnets belonging to the Corporation or to St. Helen's Hospital—fifty-one in number in 1925—these are all placed in St. Helen's swan-pit and either sold, or fatted for eating.

Swans do not breed until they are three years old, and they are very long-lived birds. A pair at Earlham died two years ago, the one from natural causes, the other a few weeks later, apparently from grief; and the Swanherd assures us that they had reared young regularly every year up to the year of their death, which there is good reason to believe occurred at eighty years. During the latter part of the life of this pair they would never allow more than four cygnets to survive; any above this number they would kill with a wing stroke within two or three weeks of hatching.

In the egg and cygnet account for 1925, here reproduced with the sanction of the City Engineer, the asterisk denotes the owner of the parent birds.

Eggs.	Cygnets.		Norwich Corporation	The Great (St. Helen's) Hospital	Duke of Norfolk	R. J. Colman.	Bishop of Norwich	Marquis of Lothian	Lord Rosebery (Postwick)	W. C. Crawshay (Brundall)	The Dean of Norwich	Mrs. Holmes (Strumpshaw)	Major Hahlo (Langley)	Col. W. Gilbert (Cantley)	Lord Stafford (Costessey)	Col. Custance (Weston)	Lady Grace Barry (Gt. Witchingham)	Taverham Hall Estate.	G. A. Berney (Morton)
8	7	River Chet	...	*4	...	*3	...	...	...	...	...	...	...	...	...	...	...	...	...
7	5	Cantley Reach	...	*3	...	...	...	...	...	*2	...	...	...	...	...	...	...	...	...
8	0	Hassingham Broad	*	...	*	...	Forsook the Nest			...	...	...	...	...	...	...	...		...
6	0	Rockland Broad	...	...	*	*	Eggs Stolen			...	...	...	...	...	...	...	...	...	...
8	7	Rockland S. Waters ...	*3	...	...	...	...	*4	...	...	...	...	...	...	...	...	...	...	...
6	4	Strumpshaw Marsh	*2	...	...	...	...	...	...	*2	...	...	...	...	...	...	...	...	...
7	4	Strumpshaw Broad	*2	...	...	...	...	...	...	...	...	*2	...	...	...	...	...	...	...
6	6	Surlingham Broad	*3	*3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
8	4	Bonnett's Broad	*2	...	...	...	...	...	...	...	...	...	*2	...	...	...	...	...	...
9	7	Postwick Reach	...	...	*3	...	...	...	*4	...	...	...	...	...	...	...	...	...	...
5	1	Six Mile Staithe	...	*	*1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9	7	Trowse Hosie Car	...	*4	...	*3	...	...	...	...	...	...	...	...	...	...	...	...	...
3	0	Lakenham River	...	*	...	*	Nest Disturbed.			...	...	...	...	...	...	...	...	...	...
6	3	Harford Bridges	**3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7	4	Keswick Reach	...	...	...	*2	*2	...	...	...	...	...	...	...	...	...	...	...	...
7	5	Cringleford Reach	*3	*2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	0	Earlham Pond	*	*	...	...	Eggs Stolen.			...	...	...	...	...	...	...	...	...	...
6	6	Keable's Farm, Earlham ...	*3	*3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7	3	Bawburgh River	*2	*1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
3	1	Bowthorpe Marshes ...	*	*1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
6	4	Lyng River	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9	7	Lenwade Mills	...	...	...	...	...	...	...	...	...	...	...	...	**4	...	...	...	...
9	5	Howard's Farm, Attlebridge	...	...	...	...	...	...	...	...	...	...	...	...	...	*4	...	...	*3
5	2	Costessey Lake	...	...	...	...	...	...	...	...	...	...	...	...	...	*2	*3	...	...
2	0	Ringland Reach	...	...	...	...	Eggs Stolen			...	...	...	...	...	**2	...	...	...	...
3	0	Costessey River	...	...	...	...	Forsook the Nest.			...	...	...	...	...	...	...	*	...	*
8	5	Drayton Reach	*3	*2	...	...	...	...	...	...	...	...	...	...	...	*	...	*	...
5	2	Hellesdon Reach	**2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
176	99		28	23	4	8	2	4	4	4	...	2	2	...	6	6	3	...	3

XII

THE HERRING FISHERY OF 1923

By Arthur H. Patterson

By an inadvertence, the reports of the Herring Fishery of 1923 and 1924 were omitted from the *Transactions*, thus breaking a continuity of the series begun by Thomas Southwell in 1881. The present notes will, it is hoped, correct this omission. The total catch of herrings from September 1st to December 18th was 389,164 crans, as against 341,383 in 1922; and the estimated value of the whole catch was £600,000. As to my authority for the statistics, I think it preferable to follow those kept by the Commissioners, which differ slightly from the Fisheries Authorities, who, I believe, begin to tabulate a little earlier than the Commissioners. The following figures, dating from the year 1913—the "record fishery"—will be interesting, as showing how hard hit was the fishing industry by the Great War, from several causes, and its subsequent recovery since 1918.

The Scottish boats considerably outnumbered the English drifters, and the figures relating to the craft given embrace the two.

Drifters Fishing out of Yarmouth.		Crans Landed.	In Lasts of 13,200 fish
1913	999 boats	824,213	82,421
1914	370 ,,	177,459	17,745
1915	185 ,,	120,122	12,012
1916	59 ,,	12,289	1,228
(Many Boats were commandeered for patrol, mine-laying, etc. A number were taken up-river and laid up.)			
1917	230 boats	76,056	7,605
1918	340 ,,	202,447	20,244
1919	850 ,,	453,571	45,357
1920	937 ,,	366,571	36,657
1921	849 ,,	358,573	35,857
1922	797 ,,	341,383	34,138
1923	684 ,,	389,164	38,916

In 1923 the fishing commenced late in July, a few local boats going out ; the herrings were fat and of excellent flavour, and were used mostly for bloater cure. To my mind a " midsummer herrin' " honestly " bloatered " by oak-smoke is the daintiest fish that can be placed upon the table. It is unfortunte that so few persons grill a bloater correctly. By always remembering the age-old adage, " first my weamb and then my back," no one will start to grill a herring back downwards ; less of its oil is lost in this way.

The majority of the boats commenced to fish in September, the Scotch fisheries coming in a little later. The greater catches occurred in October, falling off to very small takes in the beginning of December. The following figures taken from the *Eastern Daily Press* (which annually winds up the fishing with a most interesting review of the herring-voyage) will be worth noting, as they may suggest the yearly rise in number, the maximum of capture, and the ensuing diminishing of the takes as the fishery wanes :—

1922.				1923.			
Sept.	1	...	2,739	Sept.	1	...	4,096
,,	8	...	370	,,	8	...	1,819
,,	15	...	1,767	,,	15	...	6,176
,,	22	...	4,047	,,	22	...	6,019
,,	29	...	6,215	,,	29	...	7,858
Oct.	6	...	20,336	Oct.	6	...	11,140
,,	13	...	66,891	,,	13	...	36,924
,,	20	...	32,876	,,	20	...	88,236
,,	28	...	73,426	,,	27	...	94,698
Nov.	3	...	28,526	Nov.	3	...	58,401
,,	10	...	49,314	,,	10	...	26,368
,,	17	...	32,038	,,	17	...	17,694
,,	24	...	9,216	,,	24	...	19,877
Dec.	1	...	6,886	Dec.	1	...	7,141
,,	8	...	6,537	,,	8	...	1,011
	Totals	...	341,383		Totals	...	389,164

GENERAL REMARKS

The catch of 1923 may be roundly valued at £600,000 ; owners and crews having every reason to be satisfied with the

voyage. The average price per cran throughout the season was 30s., or £15 the last (old measure).

The weather was frequently of a boisterous nature, causing considerable damage to the nets, a very serious item in this industry, taking into consideration the shortage of American cotton crop (was it cornered ?), and the high cost of labour and various materials. In one week a drifter lost two fleet of nets. A fleet contains a maximum of one hundred nets, which, if all out, reach about two miles. Each net costs £6. Notwithstanding the stormy weather, not a single fisherman was lost by drowning, an excellent testimony to the trustworthiness of the boats, the fine seamanship of the fishermen, and the ability of the craft to run in in rough weather, a capability not so pronounced in a sailing boat, which had often to ride out gales. One Scotch boat sprung a leak and foundered at sea ; another drifter was rammed in harbour and sunk.

The heaviest landing of the season was on October 20th, when 404 drifters measured out 25,565 crans ; the next best was a landing of 181,457 on October 16th by 395 boats. ; on October 18th 18,419 crans were landed by 373 vessels. The best shot (one haul of the nets) was made by a Yarmouth drifter—250 crans.

The highest price for a catch of 220 crans made by a Yarmouth drifter was on December 10th, at Ymuiden, Holland, into which port she had gone with her herrings, the catch realising £957. The boats' earnings ranged from £3,300 for the voyage. There was a keen export demand for " pickles." " Cheap " herrings (usually the result of a somewhat unmanageable glut) for placing in brine in the huge cemented tanks in the fish-houses, like cellars, were consequently scarce, resulting in little work for fish-house hands during the winter months in their conversion into " reds," or selling as " salted " to the Dutchmen.

The foreign trade showed considerable improvement. To the end of November 144,382 barrels of salted herrings had gone to various ports, as widely distributed as Dantzig, Riga, Konigsberg, and ports on the Black Sea ; smoked herrings went to Germany, Greece, and Turkey. ; fresh herrings (salt and pickled) went to Germany, Holland, and Belgium.

From a Naturalist's point of view, the gulls which in vast hordes came to share in the feast was an interesting—indeed, it is now an annual—occurrence.

Rare fishes were an exception, and the hustle and haste which characterise the fishing to-day forbade much attention to sharks and cetaceans that claim their share in the harvest of the sea. A well-known boat-owner, when discussing the latter with me, remarked that he had seen a 50-foot finner whale (Greater Rorqual) opened in the Shetlands, when no less than 77½ crans (45 seven-stone baskets) of almost fresh herrings were taken from its stomach ; a small toll of the huge shoals, yet a very suggestive one.

LOWESTOFT RETURNS

Number of Fishing Vessels.	Number of Crans.	Estimated Value.
320	204,894	£287,010

XIII

THE HERRING FISHERY OF 1924

By Arthur H. Patterson

The Herring Fishing of 1924 made up with a notable catch of 654,880 crans, which far exceeded that of 1923 with 389,164 crans ; and 1922, with 341,383, a steady uprise in numbers ; and although far below the record fishing of 1913, with its 824,213 crans, which realised £100,000, the 1924 catch ended at the greater value of £1,500,000.

The number of boats this season, fishing out at Yarmouth, comprised 697 Scotch vessels, 61 of which were motor propelled, 134 Yarmouth, and 97 Lowestoft, to which may be added 4 Irish drifters. This total of 932 vessels shews the upward tendency of the industry ; and several new vessels at this time are being prepared to swell the list of next season's boats.

The landed value somewhat exceeded £2 per cran ; or £20 per last (old style), the highest average in history of the fishing. The ruling price in 1923 was 30 shillings per cran. The following figures are worth perusal, shewing as they do the

progress of the fishing from beginning to end, as compared with last season's catch :—

		1924. Crans.	1923. Crans.
Aug.	23	2,829	1,706
,,	30	5,844	4,096
Sept.	6	4,328	1,819
,,	13	6,688	6,176
,,	20	6,029	6,019
,,	27	8,085	7,858
Oct.	4	33,306	11,140
,,	11	68,193	36,924
,,	18	147,750	88,236
,,	25	62,626	94,698
Nov.	1	103,921	58,401
,,	8	84,005	26,368
,,	15	76,007	17,694
,,	22	29,562	19,877
,,	29	10,767	7,141
Dec.	6	3,252	1,011
,,	13	1,648	—
	Total	564,880	389,164

The premier day of the season was October 20th, with 32,000 crans brought in, which provided a memorable scene of life and activity in shifting and disposing one vast crop from the sea's huge harvest. On the 11th October, 27,000 crans were landed, whilst from October 13th to October 18th, the huge total of 147,750 crans were brought to Wharfage. Prices have ranged from 136 shillings per cran, for "fresh," and dropped to 26 shillings when plenty had become a burden.

Among the remarkable shots was that of the drifter "Eastholme," with 280 crans for one dip her nets glistening with the multitude of Herrings. Truly "Of all fishes in the Sea, Herring is King!" Three boats, the "Reed" "Our Favourite," and "Forerunner," each made a trip, returning with bunkers full and filled to the deck, with 300 crans apiece. The most fortunate drifter grossed about £5,000; the least lucky ranged downwards to £1,000.

General Remarks

The drifter of to-day is a vast improvement on the smaller wooden sailing luggers of 30 years ago, although the life of an iron vessel is much shorter. A new up-to-date steam drifter ready for sea, costs about £5,200, exclusive of gear ; she is about 92 feet over all, and 86 feet between perpendiculars ; with a tonnage of 98 tons gross, as against the earlier boats of 40 tons, with a length of 70 feet. The new boats have an 18 feet 6 inch beam, and a 10 foot depth of hold. The cabin for the men, no longer a close, ill-ventilated, uncomfortable cell, is furnished with rough leather cushions, flock, and even feather beds and pillows, according to fancy, and is lighted with petroline gas.

An interesting feature of the earlier part of the fishing, was the in-shoring of the dainty, well-fed, Longshore Herrings, esteemed by local epicureans as the sweetest eating of the scaly tribe. A number of small off-shore boats from Winterton to Yarmouth, came in with very payable catches, as many as 400 crans being landed in one day. They fish with a quarter mile of nets, shooting close to the shore, and run in half a right angle across the tide. It is curious that the herrings strike the net on the inshore side " as if," said a well-known boat-owner, " they worked with their tails to the shore."

Brine-pickled herrings, as usual, met with a fair continental demand, some 600,000 barrels having been handled, the greater bulk going to Germany ; many barrels of " high-dried reds " going to the Mediterranean ports. A reliable authority declares that only 5 per cent. of the catch, in the form of bloaters, reds, and kippers, are disposed of at home.

The migratory movements of the Scotch Fisher girls have become a common-place ; the girls are extremely well-behaved, and a vast improvement is shewn among the men, who drink less and pray more, great crowds flooding various places of worship on Sundays, and attending outdoor meetings when on shore-leave. Police courts, once so lively on Mondays, now rarely deal with transgressors. The girls were paid each twenty shillings per week, working in threes, two at gutting and one at packing, receiving about a shilling between them on each barrel dealt with. One crew of three sisters made a record by

dealing with 37 barrels in one day. An expert gutter can pick up a herring, gut it, give it a toss, and pick up another herring before the preceding one hits the trough, and can handle 20 herrings in one minute. Scaled and grimy when at work, on Sundays these lasses are thoroughly up-to-date in the latest fashions.

LOWESTOFT RETURNS

Number of Fishing Vessels—398.
Number of Crans—352,992.
Estimated Value, £715,159.

XIV

METEOROLOGICAL NOTES, 1924

(From observations taken at Norwich)

By Arthur W. Preston, F.R.Met.Soc.

JANUARY

Winterly weather (which had prevailed since November 8th) continued during the first ten days of January, but the frosts, though frequent, were at no time severe, and there was not much snow. There was but little frost after the 10th, but a freezing wind from the East prevailed on the 17th of an exceedingly penetrating character. There were many gloomy days with occasional bright ones during the remainder of the month. High pressure prevailed in the last week through the overlapping of a Continental anticyclone, and was accompanied by fog and drizzle. Rainfall was 0.39 ins. above normal, and mean temperature about 1 degree in excess of the average.

FEBRUARY

The sun shone for one hour only between the 4th and 16th, and the weather was very cold and winterly from the 11th day, with frost nearly every night. On the morning of the 29th, the thermometer fell to 20.8 deg. in the screen and to 15.4 deg. on the surface of the snow. This was the coldest night of the winter. No snow fell till the 12th ; after that date

it fell nearly daily though to no great depth. Rainfall was 0.30 ins. above the average, and mean temperature 2 deg. below. The month's sunshine was 32 hours deficient.

MARCH

Brilliant weather prevailed during the first 3 weeks, and although a heavy fall of snow occurred on the morning of the 3rd, there was no downfall whatever between the 3rd and the 21st. There were 154 hours of sunshine during the first 3 weeks, averaging 7.7 hours per day. During the latter part of the month, the north easterly winds were exceedingly cold and parching. The month's rainfall was 1.23 ins. below normal and it was the driest March since 1893. Mean temperature was 2.2 deg. under the average.

APRIL

Cold weather continued during the early part of April, and on the morning of the 10th the thermometer fell to 27.5 deg. in the screen, and to 22 deg. on the grass, and there were showers of snow and sleet on the 12th. On Good Friday (18th), a sudden outburst of warmth occurred, which continued till Easter Monday, giving the finest Easter holiday that had been enjoyed for some years. A great drop of temperature occurred on the afternoon of the last named day, and on the 22nd the maximum temperature was only 46.3 deg. There were 50 hours less sunshine than in March ; mean temperature was near the average, and the month's rainfall 0.34 ins. in excess. Thunder occurred on the 9th and 26th. Vegetation made a very late start.

MAY

The chief feature of the month was the abnormal rainfall, which was double the average, and was the heaviest fall recorded here in any May since 1910. Owing to constant shallow barometric depressions passing across the county, there was an unusually large number of thunderstorms, and many years have elapsed since so much electric disturbance occurred in May. Mean temperature was 2.8 deg. above normal and 4.1 deg. higher than in the previous May. Total rainfall was 3.85 ins., or 1.92 ins. above the average. The landscape at the close of the month was rich with verdure, and flowering shrubs, lilacs

and laburnums in particular gave a display of bloom such has rarely been experienced. Sunshine was 30 hours above the average, and there was only one sunless day.

JUNE

The first fortnight of the month was very unsettled and cold for the season, with frequent thunder and rain. On the 13th the thermometer did not rise above 52.6 deg. all day. On the 15th a pleasant change set in, and the temperature rose to 70 deg. and upwards every day to the 26th, on which day 80.7 deg. was reached.' Anticyclonic conditions prevailed during the greater part of this period, and there was but little rain. Mean temperature of the month was 1.3 deg. above normal. The rainfall of the first fortnight was 1.32 ins. ; that of the second half of the month only 0.28 ins. Sunshine was 9 hours deficient, and thunder occurred on six days.

JULY

Very fine weather prevailed during the first half of the month, with considerable heat at times, the thermometer reaching 80 deg. and upwards on 4 days, and rising to 85.6 deg. on the 11th. After the 16th the weather was cooler and unsettled with considerable rains and thunder at times. At Norwich the thunderstorms were much less violent than in many other places. At Ormesby on the 22nd, no less than 2.09 ins. of rain fell in a thunderstorm during three-quarters of an hour. London was also visited with several storms of a tropical character. Sunshine was 21 hours above the average. Depressions from the Atlantic were frequent during the latter part of the month. A gale from the south occurred on the night of the 3rd.

AUGUST

This month has been spoken of as "The Black August," not from an excess in the total quantity of rain, but from its frequency and the want of sunshine in the latter part of the month. After a thunderstorm on the afternoon of the 2nd, yielding 0.36 ins. of rain here, there was hardly any rain until the 17th, but from that date to the 31st it rained on every day but one, with thunderstorms on six days out of eleven, some of

them being severe. A destructive whirlwind on the 17th near Aylsham was followed by a disastrous thunderstorm next day in the same vicinity, and on the evening of the 22nd, St. Faith's Abbey was wrecked by lightning. Sunshine was about 20 hours deficient, and during the last 10 days of the month the average sunshine was but 2½ hours daily. There was a notable absence of warm days, and on only one day (11th) did the thermometer reach 75 deg. Mean temperature was 1.9 deg. deficient, but the total rainfall of the month was not far from the average, three quarters of which occurred during the second half of the month.

SEPTEMBER

This month was disappointingly cold, wet, and ungenial with only an occasional fine day. The rainfall at Norwich reached the large total of 5.22 ins., which was the greatest amount recorded here in any September since 1876. This large total was chiefly the result of 2 tropical rainstorms (without thunder) which occurred on the evenings of the 4th and 26th, on the former date 1.21 ins., and on the latter 1.54 ins. having been gauged. These falls were very local, and in other parts of the county there was far less rain. Mean temperature was near the normal, but the month was more notable for the absence of cold nights, than for the presence of warm days, the highest day temperature, which occurred on the 7th, having been only 71 deg. Sunshine was 24 hours under the average. Winds were constantly in a S.W. quarter, and the disturbed weather was the result of frequent depressions coming in from the Atlantic.

OCTOBER

The month entered with 3 fine, warm days with foggy mornings. The thermometer reached 66 deg. on the 1st. Wet and windy weather followed to the 9th, after which we had a veritable "St. Luke's summer," lasting to the 19th with several warm days, 68.8 deg. being attained on the 13th. The remainder of the month was unsettled and stormy with frequent rains. On the night of the 21st there was a torential fall of 1.27 ins. accompanied by a severe gale from the N.E. Cyclonic disturbances from the Atlantic were frequent. Mean tempera-

ture was 1.7 deg. in excess of the average, and the total rainfall was 4.20 ins., being the wettest October here since 1903, but the heaviest falls occurred by night. Sunshine was nearly normal.

NOVEMBER

With the exception of the third week, which was cold, this month was generally very mild, as many as 17 days giving a maximum temperature of 50 deg. and upwards. The mean temperature of the month, 44.6 deg., was 1.2 deg. above its normal value. There was but little frost except on the grass, but a screen minimum of 23.2 deg. on the morning of the 5th cut off the dahlias and other tender flowers. Fogs of considerable density occurred on several days, but the month was generally dry, the total rainfall having been only about half the average. A violent gale sprang up suddenly on the night of the 26th, when, at Gorleston, a speed of 60 miles per hour was recorded. Sunshine was very deficient. There were 10 sunless days, and 12 other days with less than 2 hours sunshine.

DECEMBER

This was a mild and stormy month. The mean temperature (42.7 deg.) was 3.8 deg. above the normal, and there were many spring-like days. Great fogs occurred at times, notably on the 10th and 11th, but the month was chiefly noted for its violent gales and strong winds, the heaviest gale having been on the 27th, which was widespread in its destruction. Sunshine was nearly normal, but there were 15 sunless days. The wind was southerly or south-westerly almost throughout the month, and nearly all the gales came from that quarter, through a constant series of cyclonic depressions from the Atlantic.

The Seasons

Tables of Mean Temperature and Rainfall of the four seasons (December, 1923, to November, 1924, both inclusive) and compared with those of the previous five years and with the average.

TEMPERATURE

Seasons	1919	1920	1921	1922	1923	1924	Average	Departure of 1924 from average
	degrees	degrees	degrees	degrees	degrees	degrees	degrees	degrees
Winter -	38·7	41·2	41·7	40·2	41·3	37·3	38·4	— 1·1
Spring -	46·9	50·0	49·6	46·9	47·3	46·7	46·7	0·0
Summer -	58·9	58·9	62·1	57·9	60·3	60·2	60·2	0·0
Autumn -	46·8	50·2	51·3	48·4	47·8	51·2	50·1	+ 1·1
Year - Jan. to Dec.	47·6	50·0	51·5	48·3	48·7	49·4	48·8	+ 0·6

RAINFALL

Seasons	1919	1920	1921	1922	1923	1924	Average	Departure of 1924 from average
	ins.	ins.	ins.	ins.	ins	ins.	ins.	ins.
Winter -	10·29	8·12	5·58	9·86	8·07	7·40	6·21	+1·19
Spring -	4·98	6·61	4·17	5·32	3·95	6·58	5·55	+1·03
Summer -	6·15	7·34	2·57	10·54	6·45	6·08	6·89	—0·81
Autumn -	7·49	3·76	4·65	6·05	8·84	10·86	7·83	+3·03
Year - Jan. to Dec.	29·99	24·00	15·71	32·49	27·74	30·77	26·48	+4·29

The winter was the coldest since 1917 and slightly wetter than the average. The mean temperature of both the spring and summer was normal ; the rainfall of the former slightly in excess and of the latter slightly in defect. The autumn was rather warmer than usual with a rainfall 3 inches in excess of its average, due to the very wet September and October. It was the wettest Autumn since 1892.

THE YEAR

The Mean Temperature of the year was 49.4 deg., which was 0.6 deg. above the average, and 0.7 deg. above that of the previous year. While January exceeded the average by 1 deg. the following four months were all below normal. June to

July were above, August below, and the remaining four months above, the greatest departure having been December, which was 3.8 deg. above. The hottest day was July 11th (85.6 deg.) which, by a coincidence, was the same date as that of the warmest day of the previous year, and the coldest day was February 29th (with 20.8 deg.), and it is remarkable that in such a long and protracted winter the screened thermometer did not once fall below 20 deg. The rainfall of the year (30.77 ins.) was 4.29 ins. above the average, and, rainy as was the reputation it left behind it, the total was about 2 ins. less than in 1922 and 1916, and more than 4 ins. less than in 1912. Sunshine was 66 hours deficient, the sunniest month was July with 231 hours and the dullest months November and December with 43 and 44 hours respectively. The winter was long and cold, and may have been said to have lasted from November 8th until the third week of April, with a further spell later lasting into May. The only really fine summer weather was in the second half of June and first half of July, after which there was hardly a day which could be called really warm, and there was much damp, cloudy, chilly weather, and, at times great rains, particularly in September and October. The year ended with a sequence of gales from the Atlantic accompanied by great mildness and hardly a vestige of winter. There was much thunder during the summer, particularly in May and August, and some of the storms were severe, although less so than in London. There was a fine fruit crop, the result of the abundance of bloom in the spring, its late start and the absence of frost after the first week of May. The year has left behind it a bad reputation chiefly by the absence of any real summer weather after mid-July, the frequency of the rains, and the general ungenial character of the late summer and autumn. Best thanks are again due to Mr. Willis for his sunshine returns.

MR. PRESTON'S METEOROLOGICAL RECORDS FOR 1924

Month 1924	BAROMETER					THERMOMETER					HYGRO-METER	SUN-SHINE	RAINFALL		WIND							
	Highest	Date	Lowest	Date	Mean	Highest	Date	Lowest	Date	Mean	Mean Relative Humidity 9 a.m	Hours	Inches	No. of Days	Direction and Days							
															N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
	in.		in.		in.	°		°		°	%											
Jan.	30.54	26	29.23	9	29.928	50.2	12	25.7	5	38.7	91	58.4	2.35	20	1	0	2	7	11	2	2	6
Feb.	30.60	16	29.14	10	29.981	49.4	4	20.8	29	36.7	86	47.0	1.94	19	4	5	3	4	0	2	3	8
March	30.45	7	29.14	2	29.872	58.4	22	23.0	7	39.4	78	188.0	0.68	8	2	6	3	7	2	3	6	2
April	30.46	19	29 24	12	29.834	64.1	20	27.5	10	45.7	70	138.6	2.05	14	6	6	4	1	2	1	4	6
May	30.27	17	29.49	25	29.842	77.6	14	36.2	5	55.0	76	175.3	3.85	19	1	1	5	2	4	9	8	1
June	30.25	14	29.46	11, 21	29.973	80.7	26	37.0	3	59.4	71	200.8	1.60	17	1	2	2	3	4	4	8	6
July	30.28	14	29.21	3	29.844	85.6	11	45.2	1	62.1	73	231.3	2.09	16	1	0	3	1	4	5	9	8
Aug.	30.41	9	29.25	17	29.800	75.4	11	42.2	28	59.1	81	163.2	2.39	20	3	0	1	0	7	10	4	6
Sept.	30.27	27, 28	29.39	9, 2	29.803	71.0	7	37.0	28	57.5	83	125.7	5.22	21	0	4	1	2	6	9	5	3
Oct.	30.44	14	29.41	30	29.881	68.8	13	32.5	18	51.6	89	102.3	4.20	17	1	1	5	5	6	8	3	2
Nov.	30.53	17	29.27	26, 27	30.041	58.0	1	26.8	18	44.6	87	42.7	1.44	18	1	1	4	9	4	2	4	5
Dec.	30.48	20	29.12	27	29.926	54 0	4	28.5	11	42.8	90	43.5	2.96	16	0	0	0	1	17	9	3	1
Means					29.894					49.4	81											
Extremes & Totals	30.60	Feb. 16	29.12	Dec. 27		85.6	July 11	20.8	Feb. 29			1516.8	30.77	205	21	26	33	42	67	64	59	54

XV

MISCELLANEOUS NOTES AND OBSERVATIONS

White-Beaked Dolphin.—On July 7th, 1925, I received word from the Deputy Receiver of Wreck, Great Yarmouth, that a "large fish," nine feet long by five in girth, had been washed ashore at Happisburgh, the tail being absent and the carcase in a decomposed state. At my request the local Coastguard kindly sent to me one half of the lower jaw, which was in bad condition, the teeth having all gone and their sockets all filled with chloride of lime. Examination showed that there had been either twenty-five or twenty-six teeth in this half jaw, the animal having possessed in all about 100 teeth. I sent the specimen to Sir Sidney F. Harmer, F.R.S., at the British Museum (Nat. Hist.) who replied as follows :—" I am very much interested in the lower jaw of the Happisburgh whale. In my last Report, No. 9, on Stranded Whales, I called attention to the relatively large number of aged specimens of *Lagenorhynchus albirostris* with no teeth, or with teeth and jaws in a diseased condition. This appears to be another of the same kind. The length of the jaw and that of the row of teeth seem to be a very good clue to the species ; and I have little doubt, from these characters, that your specimen is a White-beaked Dolphin, as you suppose."—A. H. Patterson.

Melanistic Common Rat.—A black variety of the Common Rat, *Rattus Norvegicus*, which I saw, was killed at Shimpling in March, 1924, and sent to the Norwich Castle Museum. It represents the Hibernian race, which, Mr. Martin Hinton tells me, is now becoming common in many parts of Britain.—A. H. Patterson.

Norfolk Summer Woodcock.—Mr. H. E. S. Upcher reports that on July 31st, 1925, his keeper flushed a Woodcock in one of his woods at Sheringham. There is ample evidence that the bird nests in Norfolk, though it is rarely seen during the summer months.

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1877—1925

Mr. Upcher also reports that he found a Grey Crow feeding on a dead rabbit at Sheringham on August 27th, 1925. This is an early date for an immigrant Hoodie ; on the other hand, the species is known to nest further along the coast—in the Horsey district.—EDITOR.

XVI

WILLIAM GEORGE CLARKE, F.G.S.

(1877—1925)

IT is with a sense of very deep regret that we have to record the death of W. G. Clarke, in the prime of life, one of the deservedly best known all-round field naturalists in East Anglia. After a short illness, of sudden onset, he died on June 15th, 1925.

William George Clarke was born at Stokesley, Yorkshire, on the 7th January, 1877, so that strictly, Norfolk was his adopted county—a fact over which he often used to joke. His parents, Mr. and Mrs. J. W. Clarke, were, however, well-known Thetford people, and it was there that he spent his boyhood. He was educated at the Grammar School. His father was in business in the town as a printer, so that it was natural that his son should be apprenticed to him.

Even as a boy he felt the appeal of the wild and became a collector of birds' eggs, butterflies, and geological specimens. An event that was to have momentous consequences in his life occurred in late boyhood, when he came across a copy of Sir John Evans' " Ancient Stone Implements," and as a result discovered the rich mine of prehistoric material that, hitherto almost unnoticed, existed in the district round Thetford and Brandon. A tireless and methodical searcher, he had in a few years built up a wonderful collection, chiefly of neolithic implements, which has since found its way to the British Museum. In 1894 he was elected a member of the Norfolk and Norwich Naturalists' Society, and it is not without significance that his first paper, read on the 27th November in that year, was devoted to a lengthy study of " Neolithic Man in the Thetford District." His work gained him a local reputation, and

when Lord Avebury, then Sir John Lubbock, was staying in the neighbourhood, he looked up the young archæologist, as a matter of course.

After finishing his apprenticeship, he worked for a period at Clay's Printing Works, Bungay, and also held a post in London. He could not, however, remain long shut off from the country, and it was with relief that he accepted the opportunity of entering journalism, and came to Norwich as reporter on the staff of the "Norwich Mercury." Soon after moving to the city he married Miss Holden, of Thetford, who, with a daughter and son, survives him.

Work on the "Mercury," of which he later became sub-editor, gave Mr. Clarke the opportunity of writing on every conceivable subject. His week-ends he spent cycling about the country, and the outcome of this energetic habit was a minute acquaintance with Norfolk as a whole. Curiously, he had not yet taken up the serious study of botany. But as geologist, prehistoric worker, and topographer, he was already gaining a more than local reputation. A series of articles to the "Eastern Daily Press" under the pseudonym of "Wandering Will," attracted much attention at the time. In addition he contributed to his own paper the fruits of hours of indoor research work as well as countless topographical articles. As an example of his tireless industry in out-of-the-way fields of research, it may be mentioned that he had worked through the reports of all the Norfolk Assizes in the eighteenth century, gathering a mass of valuable sociological material.

In 1908 Mr. Clarke founded the Prehistoric Society of East Anglia in conjunction with Mr. W. A. Dutt, Mr. H. H. Halls, and the late Dr. W. Allen Sturge. The first proceedings of the society, which, while keeping its East Anglian name, has now taken its place as a national body with members in all parts of the country, were published in 1911. His work as hon. secretary of the society and editor of its proceedings brought him into contact with such leading scientists as Sir Ray Lankester, Sir Arthur Keith, Mr. Reid Moir, Mr. F. W. Harmer, and others. Among his notable achievements as a prehistorian were his early recognition of the existence of worked flints

beneath the Norwich crag, and his editorship of the report of the excavations at Grimes' Graves.

Shortly before starting the Prehistoric Society, Mr. Clarke had taken up the serious study of botany, and at a later date founded the Norwich Rambling Club as an offshoot of the Norwich Reading Circle. He was an ideal guide for country rambles, and "Ask Clarke" became almost a catchword with those who were privileged to accompany him. Naturally, he was most at home on the familiar "brecks" of South-West Norfolk, and it was his pen that coined "Breckland," a name which has now passed into the language.

As was the case with so many others, the war brought a serious interruption to his labours. For a time he served with the Norwich Cyclist Volunteers and later in the Army Pay Corps. While still in the army he was elected President of the Norfolk and Norwich Naturalists' Society, his presidential address being on the Norfolk Commons, of which he had compiled a preliminary survey in 1910.

On demobilisation he became Sub-Editor of the "Norfolk News," and at the time of his death held the position of leader writer on the staff of the "Eastern Daily Press."

The initials "W. G. C." quickly became familiar to a wide public, and in Norwich civic recognition of his worth was not long in coming, for he was co-opted a member of both the Castle Museum and the Public Library Committees, on both of which he rendered valuable service to the city. He had long been a member of the committees of the Norfolk and Norwich Naturalists' Society and of the Prehistoric Society of East Anglia, and only this year was elected to the committee of the Norfolk and Norwich Archæological Society.

With his pen he aided largely towards the success of the appeal in 1923 of the Norfolk and Norwich Naturalists' Society for the purchase of Scolt Head Island, and it was only natural that he should have been selected by the National Trust as one of the local committee for the management of the island when the property was handed over to that body. He was also a member of the Wild Birds Protection Committee of our Society, and, working under a sympathetic Editor, was the author of much useful propaganda on the subject of bird protection in the local press.

To our own Transactions he contributed many valuable papers, and of late years rarely has a Part been issued without an article from him.

Despite his modesty it was impossible to prevent his fame spreading beyond the confines of East Anglia. He had long had quite a European reputation among prehistorians. Shortly before the end of the war he was elected a Fellow of the Geological Society, an unsought honour which was greatly appreciated. London publishers, too, began to realise that here was a man of no common stamp. In 1921 he published his first important book, " Norfolk and Suffolk," which treated local history and topography from a new angle, and although written with his usual careful avoidance of purple patches, nevertheless contained some fine descriptive passages. A smaller book, " Our Homeland Prehistoric Antiquities," had been written previously, but owing to delays in the press was not published until later. A third book on Breckland was, fortunately, completed only a few months before his illness and has since been published. He finished it with a great sense of satisfaction, conscious that into it he had put some of his best work. It embodies the results of years of investigation in the little known area of which it deals. As a final effort it is a fitting monument to his memory.

The death of " W. G. C.," as he was widely known, is an irreparable loss to natural history and archæology in Norfolk. He probably had a closer knowledge of the county than any man who has ever lived. He had been on every one of its commons and trodden nearly all its footpaths. He had a wonderful memory for the haunts of wild flowers and the sites of prehistoric settlements, and possessed the rare knack of imparting something of his enthusiasm to those who at lecture or on ramble came into contact with him. A specialist in not one, but three or four fields, with the scientist's passion for exactness and for recording, he was undoubtedly one of the best all-round naturalists that has ever resided in this county.

It was typical of the man that in all his research work he thought of those who would come after him. His one idea—as a long series of papers to various societies and many of his newspaper articles testify—was to place facts on record.

Accuracy with him came before style, and when, as often happened, he could not help writing a fine descriptive passage, he was almost tempted to regard it as a lapse.

In person spare and slight, he was able on foot or on cycle to perform feats of physical endurance that would leave bigger men far behind. In his youth he had been a footballer, and this, or his singularly equable and unruffled temperament, possibly accounted for the indifference with which he faced the weather. Storm or sunshine, heat or cold, it mattered not, provided he could pursue his quest. He loved Nature in all her moods, and she in turn imparted to him her secrets.

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1925-26

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1926 Bartram W., Honingham Thorpe, Colton, Norwich
1915 *Bedford Her Grace the Duchess of, F.Z.S., F.L.S., Hon. M.B.O.U., *V.P.*, Woburn Abbey
1922 Bedwell E.C., "Bruggen," Brighton Road, Coulsdon, Surrey
1912 Beevor Sir H., Bart., Hargham Hall, Norfolk
1921 Bell R. C., Woodbastwick Old Hall, Norwich
1911 Beloe E. M., F.S.A., 27, New Conduit Street, King's Lynn
1882 Bennett Arthur, A.L.S., *Hon. Mem.*, 5, Thanet Place, High Street, Croydon
1924 Benson E. F., Lamb House, Rye
1911 Berners Geoffrey, Woolverstone Park, Ipswich
1921 Berney F. L., R.A.O.U., Barcarolle, Longreach, Queensland
1920 Berney R. G. G., The Grange, St. James, Halesworth, Suffolk
1925 Best Miss M. G., F.Z.S., M.B.O.U., 123, Cheyne Walk, Chelsea
1869 O.M. Beverley M., M.D., *V.P.*, Overstrand, Norfolk
1877 Bidwell E., 12, Woodberry Grove, Finsbury Park, London, N. 4.
1921 Bignold C. R., Loddon House, Loddon, Norfolk
1895 Birkbeck H., High House, Westacre, Norfolk
1901 Birkbeck H. A., King's Lynn
1921 Birkbeck Oliver, Little Massingham House, King's Lynn
1926 Birkin H. R. S., Tacolneston Hall, Norfolk
1925 Blofeld T. C., Hoveton House, Norwich
1887 Boardman E. T., How Hill, Ludham, Norfolk
1896 Boileau Sir M. C., Bart., Kettcringham Park, Wymondham, Norfolk

Elected.

1902 Booth H. B., Ryhill, Ben Rhydding, Yorks.
1925 Borley J. O., O.B.E., Marine Biological Laboratory, Lowestoft
1919 Borrer Clifford, 6, Durham Place, Chelsea, W. 3.
1924 Boyd A. W., Frandley House, Near Northwich. Cheshire
1915 Bradfer-Laurence H. L., F.S.A., King's Lynn
1923 Brereton Mrs., Gresham, Holt
1884 Brittain H., 1, Fairfield Road, Town Close, Norwich
1924 Britton Eric, 43, Cambridge Street, Norwich
1924 Broderick Miss, Cathedral Close, Norwich
1912 Brooks J. R., North Walsham Wood, Norwich
1925 Brooks Mrs., North Walsham Wood
1925 Brooks Miss Nancy, North Walsham Wood
1926 Brown Miss I., Geeton Cottage, Postwick Lane, Brundall
1921 Brown Mrs. Du Puis, Chedgrave Manor, Loddon
1921 Bruton M. S., The Post Office, Aylsham
1925 Bryan H., "Lanthwaite," Eaton, Norwich
1922 Bulwer Lt.-Col. E. A., Heydon Grange, Aylsham
1925 Bulwer Mrs., Heydon Grange, Norwich
1922 Burlingham S. S., 89, High Street, King's Lynn
1923 Burnand L. B., Bushy Place, Aylsham
1895 Burrell W. H., F.L.S., 44, West View, Horsforth, Yorks.
1923 Burton Miss Amy, Newmarket Road, Norwich
1923 Burton Arthur, M.D., Cromer
1923 Burton Mrs. Arthur, Cromer
1882 Burton S. H., F.R.C.S., St. Giles Street, Norwich
1925 Busittil F. P., Swardeston, Norwich
1926 Butler S., Lime Grove, Lime Tree Road, Norwich
1921 *Buxton Anthony, Knighton, Buckhurst Hill, Essex
1884 Buxton A. F., Fairhill, Tonbridge
1887 Buxton E. G., F.Z.S., Catton Hall, Norwich
1874 Buxton Geoffrey F., C.B., F.Z.S., Hoveton Hall, Norwich
1923 *Buxton Major Ivor, Dunham Lodge, King's Lynn
1906 Buxton R. G., Petygards, Swaffham, Norfolk
1906 Buxton W. L., Bolwick Hall, Marsham, Norwich

C

1925 Calthrop Miss J., Chester House, Chester Place, Norwich
1909 Calvert E. M., Eaton, Norwich
1909 Campbell-Taylor J. E., Mavisthorne, High Street, Southover Lewes
1909 Cann Miss F. A., Groveleigh, Cleveland Road, Torquay
1925 Canterbury Viscount, Bergh Apton, Norwich
1923 Carruthers Douglas, Barmer Hall, King's Lynn
1907 Caton Rev. R. B., Great Fakenham Rectory, Thetford
1902 Cator John, Woodbastwick Hall, Norfolk
1923 Cator H. J., Ranworth Old Hall, Norwich
1922 Cator Miss Diana, Happisburgh, Norfolk
1911 Chamberlin Rev. C. M., Witton Rectory, Norwich
1924 Chambers Miss M. H., 27, College Road, Norwich
1925 Charlesworth J. B., Gunton Hall, Lowestoft
1881 Chase R. W., Herne's Nest, Bewdley, Worcestershire
1919 *Chasen F. N., The Raffles Museum, Singapore
1924 Chittock A. T., 12, Chapel Field North, Norwich
1924 Chittock Mrs. A. T., 12 Chapel Field North, Norwich
1907 Christie J. A., M.P., Framingham Manor, Norwich
1923 Citters A. van, Broadlands, Wroxham
1923 Claridge Mrs., St. Giles' Plain, Norwich
1925 Clarke Mrs. F., "Coniston," Newmarket Road, Norwich
1923 Clayton J., Cecil Road, Norwich
1911 Cleather Rev. W. S., Barningham Rectory, Norfolk

Elected.

1923 Clodd Mrs., Strafford House, Aldeburgh, Suffolk
1925 Cobbold J. D., Holy Wells, Ipswich
1887 *Cocks A. H., M.A., F.Z.S., Poynetts, Skirmett, Henley-on-Thames
1909 Coke Right Hon. Viscount, Holkham, Norfolk
1923 Cole Lowry A. C., The Lodge, Sprowston
1923 Cole Mrs. Lowry, The Lodge, Sprowston
1923 Collin J. F., 419, Unthank Road, Norwich
1924 Collings Dr. D. W., The Mount, Southwold
1921 Colman Capt. G. R. R., Bixley Manor, Norwich
1903 *Colman Miss E. M., Carrow Abbey, Norwich
1903 *Colman Miss H. C., Carrow Abbey, Norwich
1881 Colman Russell J., Crown Point, Norwich
1925 Cook G. J., 143, Newmarket Road, Norwich
1925 Cook T. A., Sennowe Hall, Guist, Norfolk
1925 Copeman T., 5, Claremont Road, Norwich
1919 Copeman W. O., 76, Highland Road, Norwich
1923 Coward T. A., M.Sc., Brentwood, Bowdon, Cheshire
1921 Cozens-Hardy A., Oak Lodge, Sprowston, Norwich
1886 Cross J. M., Acle

D

1910 Dalby Rev. Alan, M.A., The Vicarage, Leamington-Hastings, Rugby
1922 Dallas Chas. C., Eastley Wootton, New Milton, Hants.
1920 Davey Guy, Aldborough, Norwich
1914 Davies H. C., Old Lakenham, Norwich
1923 Daukes Maj. A. H., 22, Egerton Terrace, London, S.W.2
1901 Day Donald D., F.R.C.S., All Saints' Green, Norwich
1917 Deacon G. E., Brundall, Norwich
1925 Dew Mrs., Boat House, Blakeney
1924 Dewing J. R., 48, London Road, King's Lynn
1891 Digby A., Cley-next-the-Sea
1918 Donnison H., Boston, Lincolnshire
1916 Doughty Chester G., 7, Upper Cliff Road, Gorleston-on-Sea

E

1911 Easter W. C., 99, City Road, Norwich
1877 Edwards J., F.E.S., *Hon. Mem.*, Colesborne, Cheltenham
1924 Elliott T. B., 8, Brunswick Road, Norwich
1923 Evans A. H., 9, Harvey Road, Cambridge
1897 Evans H. Muir, M.D., Turret House, South Lowestoft
1919 Evans-Lombe Major E., Marlingford Hall, Norwich

F

1885 Falcon Michael, Sprowston Hall, Norfolk
1922 Ferrier Miss J. M., Hemsby Hall, Norfolk
1922 Ferrier R. F. E., F.S.A., Hemsby Hall, Norfolk
1924 Fisher K., The School, Oundle, Northants
1923 Fisher Sidney, Oaklands, St. Clement's Hill, Norwich
1924 Fleming James M., "Drumwalt," The Long Road, Cambridge
1925 Fletcher Major L., D.S.O., Ashwellthorpe Hall, Norwich
1880 *Fletcher W. H. B., Aldwick Manse, Bognor
1922 Fonnereau Miss Hilda, The Old Farm, Walcot-on-Sea, Norfolk
1883 Forrester J. B., 52, Thorpe Road, Norwich
1924 Fowler Major E., Gunton Old Hall, Lowestoft
1924 Fowler Miss E., Gunton Old Hall, Lowestoft
1922 Frere Sir Bartle H. T., South Walsham Hall, Norfolk
1926 Fuller A. W., 18, Kerrison Road, Norwich

Elected.

G

1914 Gadesden Miss F., White Gates, Gresham, Norwich
1902 Garstang Walter, D.Sc., The University, Leeds
1924 Gay Miss Ellen, Thurning Hall, Guist, Norfolk
1925 Gay Miss G. A., Ardleigh House, Hornchurch, Essex
1922 Gaze R., 105, Earlham Road, Norwich
1903 Geldart Miss Alice M., Cotman Road, Norwich
1926 Gilbert Brig.-Gen. A. R., C.B.E., D.S.O., Sprats Green, Aylsham
1926 Gilbert Mrs. A. R., Sprats Green, Aylsham
1908 Gilbert R. T. E., Ashby Hall, Norfolk
1923 Gill S. T., Rupert Street, Norwich
1921 Glover T., Cliff House, Norwich
1909 Goodchild Herbert, The Chestnuts, Unthank Road, Norwich
1924 Gooch Sir Thos., Bart., Benacre Hall, Suffolk
1924 Gooch Brian, Benacre Hall, Suffolk
1924 Gooch Richard, Benacre Hall, Suffolk
1901 Goose A. W., 10, Sandringham Road, Norwich
1922 Gossage Mrs., Leet Hill, Kirby Cane, Norfolk
1922 Gossage Col. W. W., Leet Hill, Kirby Cane, Norfolk
1921 Graves Mrs., Oulton Lodge, Aylsham, Norfolk
1919 Greatorex H. A., Witton, Norwich
1921 Green Capt. S. V., Sutton Lodge, Ipswich Road, Norwich
1924 Green Maj. E. A. Lycett, Ashfield, York
1918 Gresham School The, Holt, Norwich
1913 *Grey of Fallodon, The Rt. Hon. Viscount, K.G., Fallodon, Lestbury, Northumberland
1926 Gunn F. E., 84, St. Giles Street, Norwich
1918 Gurney Major Cecil F., Berry Hall, Walsingham
1896 *Gurney Sir Eustace, M.A., F.Z.S. *V.P.*, Walsingham Abbey, Norfolk
1893 *Gurney Gerard H., F.Z.S., Keswick Hall, Norwich
1925 Gurney Miss Rosemary, Narborough, King's Lynn
1901 Gurney Q. E., Bawdeswell Hall, Norfolk
1894 *Gurney Robert, M.A., F.L.S., F.Z.S., *Hon. Treasurer*, Ingham Old Hall, Norfolk
1918 Gurney Mrs. Robert, Ingham Old Hall, Norfolk

H

1924 Hadfield Travers, Stoneleigh, Knutsford, Cheshire
1892 *Haigh G. H. Caton, Grainsby Hall, Great Grimsby
1905 Halls H. H., 130, Hall Road, Norwich
1908 Hamond Lieut.-Com. C.E., R.N., 40, Lyndhurst Road, Lowestoft
1906 *Hamond Major Philip, D.S.O., Morston, Holt, Norfolk
1923 Hankin E. H., Sc.D., *President*, "Lanbeevor," Wroxham, Norfolk
1923 Harbord Miss P., Mousehold House, Norwich
1919 Harker Miss Sylvia, Blofield Hall, Norwich
1908 Harker William, Blofield Hall, Norwich
1923 Harmer Russell T., The Grange, Rackheath, Norwich
1881 *Harmer Sir Sidney, K.B.E., F.R.S., 30, Courtfield Gardens, London, S.W. 7
1925 Harper Mrs. A. M., The Mansion, Great Yarmouth
1906 Harris Rev G. H., St. Paul's Vicarage, 47, Trafalgar Road, Moseley, Birmingham
1925 Hartcup Miss, Dial House, Cathedral Close, Norwich
1923 Hastings Lord, Melton Constable Park, Norfolk
1925 Hemingway P. H., Hamara, Wroxham
1925 Hewitt H. Dixon, F.I.C., 25, Croxton Road, Thetford
1925 Heywood R., Pentney House, Narborough, Norfolk
1923 Hibberd Rev. H., Burnham Thorpe Rectory, King's Lynn
1893 *Hill Alexander, M.D., F.R.S., Highfield Hall, Southampton

Elected.

1919 Hinde Dr. E. B., 31, Mount Pleasant, Norwich
1891 Hinde F. C., *Hon. Librarian*, Oaklands House, Cringleford, Norwich
1923 Hines E. S., 10, Parker Road, Norwich
1915 Hitchcock Arthur, Tamworth House, Tennyson Road, King's Lynn
1921 Hoare Miss Marjorie, 17, Camberley Road, Norwich
1919 Horsfall Charles, Stody Lodge, Melton Constable, Norfolk
1925 Hose Dr. C., F.R.G.S., "Redleaf," Riddlesdown Road, Purley, Surrey
1923 Hoskins Maj. Gen. Sir Reginald, Army and Navy Club, London
1919 Howard Miss D. D., West Parade, Norwich
1919 Howard H. J., 6, College Road, Norwich
1887 Howard R. J., Shear Bank, Blackburn
1924 Howes Miss Alice, 26, Cathedral Close, Norwich
1923 Hunter Miss E. M., Mattishall Hall, East Dereham
1923 Hunter H. M., Mattishall Hall, East Dereham
1899 Hurrell H., 25, Regent Street, Gt. Yarmouth
1915 Hutchinson Donald, M.D., 2, Gordon Road, Lowestoft

J

1921 Jarrold T. H. C., Pine Banks, Thorpe St. Andrew
1891 Jarrold W. T. F., Thorpe St. Andrew, Norwich
1896 *Jodrell Sir Alfred, Bart., Bayfield Hall, Norfolk
1909 Jickling Colonel C. M., Smallburgh Hall, Norfolk
1926 Jolly Ll. B., Aylmerton Hall, Norfolk
1923 Jolly T. L., Church Farm, Aylmerton, Norfolk
1885 Jones Sir Lawrence, Bart., 39, Harrington Gardens, London, S.W., 7.
1926 Jourdain Rev. F. C. R., Waveney Lodge, Ditchingham, Norfolk

K

1926 Keith E. C., Swanton Morley, East Dereham
1897 Kerrison Colonel E. R. A., C.M.G., Burgh Hall, Aylsham, Norfolk
1925 Kerrison Mrs., Burgh Hall, Aylsham, Norfolk
1912 Ketton-Cremer W. C., Felbrigg Hall, Norfolk
1904 Kinder Rev. E. H., Kirby Bedon Rectory, Norfolk
1898 Knight Edward, Keswick Old Hall, Norwich

L

1925 Labouchere P., The Lodge, Burnham Thorpe, King's Lynn
1926 Lane D. H., Framingham Pigot, Norwich
1918 Lascelles Miss Susan, Swanton Novers, Norfolk
1869 O.M. Laurence Canon Rev. J. A., Dilham Rectory, Norwich
1926 Leconfield Lady, Petworth House, Petworth, Sussex
1921 le Strange C., Hunstanton Hall
1909 Leicester The Right Hon. the Earl of, G.C.V.O., C.M.G., *V.P.*, Holkham
1899 Leney F., Castle Museum, Norwich
1923 Lipscomb R., Hannington House, Fakenham
1923 Lipscomb Mrs., Hannington House, Fakenham
1924 Little J. E., 19, The Avenue, Hitchin
1923 Livesay Surg. Cap. R.N., St. Andrew's Hospital, Thorpe, Norwich

Elected.

1922 Livesay Mrs., St. Andrew's Hospital, Thorpe St. Andrew
1922 Lloyd Capt. L., Taverham Mill, Norwich
1925 Lloyd Mrs., Taverham Mill, Norwich
1881 Long F., The Close, Norwich
1899 Long S. H., M.D., F.Z.S., M.B.O.U., *Hon. Sec.*, 31, Surrey Street, Norwich
1907 Long Mrs. S. H., 31, Surrey Street, Norwich
1919 *Long Miss E. M., 31, Surrey Street, Norwich
1924 Long Miss M., 10, The Close, Norwich
1923 Long G. S. B., St. Giles Plain, Norwich
1921 Lucas The Baroness, Horsey Hall, Great Yarmouth
1925 Luddington Miss, Wallington Hall, King's Lynn
1925 Luddington Mrs., Wallington Hall, King's Lynn

M

1924 MacKenzie Miss G., The Cottage, Ingworth, Norwich
1923 Mackie, Mrs., The Red Cottage, Bergh Apton, Norwich
1923 *Macpherson A. Holte, 21, Campden Hill Square, Kensington, W.8
1923 Mann Miss, Thelveton Hall, Scole, Norfolk
1905 Mann Sir Edward, Bart., Thelveton Hall, Norfolk
1906 Marriott F. W. P., 11, Queen Street, Norwich
1892 Marsham Major H. S., Rippon Hall, Marsham, Norfolk
1912 Mason A., Bank Plain, Norwich
1925 Massingham Hugh, 1A, Winter Road, Norwich
1911 Master George, M.D., Bury St. Edmunds
1893 Mayfield A., F.L.S., Mendlesham, Stowmarket
1922 McKenna Mrs. Reginald, 36, Smith Square, Westminster, S.W. 1.
1926 McLean Colin, Humbletoft, East Dereham
1926 Meade Miss P., Croxton, Thetford
1898 Meade-Waldo Edmund G. B., Stonewall Park, Edenbridge, Kent
1877 Miller Henry, Bosmere House, Norwich Road, Ipswich
1922 Miller Osborne, "Heathlands," Fakenham, Norfolk
1923 Minns Mrs. E., Hammond's Wood, Frensham, Surrey
1923 Moppe Lewis E. van, Cliffside, Overstrand
1924 Mortimer Ernest, The Red House, Wrentham, Suffolk
1922 Mountfield Rev. D., Horsford Rectory, Norwich
1922 Mountfield Miss M., Horsford Rectory, Norwich
1921 Moxey J. G., Framingham Hall, Norwich
1919 Moxey Llewellyn, Framingham Hall, Norwich
1923 Moxham M. C., Aldborough, Norwich
1920 *Mullens Major W. H., Westfield Place, Battle, Sussex
1921 *Murton Mrs., Cranbrook Lodge, Kent

N

1904 Napier A. J., *Hon Mem.*, Brães, St. Mawes, Cornwall
1926 Nash J. E., 27, Lansdowne Grove, Neasden, London, N.W. 10
1910 Nash J. T. C., M.D., D.P.H., Shirehall, Norwich
1922 Nevill Rev. R. W., Beighton Rectory, Norwich
1925 Neville R. J. N., M.P., Sloley Hall, Norfolk
1911 Newman L. F., St. Catherine's College, Cambridge
1893 Newton E. T., F.R.S., *Hon. Mem.*, H.M. Geological Survey Office, 28, Jermyn Street, London
1913 Newton W. C. F., The Meadows, Saham Toney, Watton
1889 Nicholson W. A., *Hon. Mem.*, 81, Surrey Street, Norwich
1915 Nightingale S. R., Scratby Hall, Great Yarmouth
1915 Norwich Public Library
1919 Norgate Philip, Swanington, Norfolk

Elected.

O

1921 Offord Miss Georgina, St. Giles' Plain, Norwich
1914 Oliver Prof. F. W., F.R.S., *Hon. Mem.*, University College, London, W.C. 1
1924 Orgill Miss M. A., Garboldisham, Diss

P

1889 Page G. W., Walsingham, Norfolk
1919 Pain Percy, Dersingham, King's Lynn
1913 Paine Rev. N. W., Great Melton Rectory, Norfolk
1919 *Palmer Mrs. P. Hurry, "Red Roofs," North Drive, Great Yarmouth
1912 Parker H., 10, Aspland Road, Norwich
1925 Parker Miss Molly Hyde, Smeetham Hall, Sudbury, Suffolk
1921 Parker R. E., Easton, Norwich
1883 *Parkin Thomas, M.A., F.Z.S., High Wickham, Hastings
1873 Partridge Rev. W. H., M.A., St. Peter's, Sandown, I. of W.
1923 Partridge F. H., St. Helier, Hunstanton
1889 Patterson Arthur H., *Hon. Mem.*, Ibis Lodge, Hellesdon, Norwich
1920 Patteson Mrs. F. E., Great Hautbois House, Norfolk
1901 *Paul J. J. Dawson, Eaton Grove, Norwich
1911 *Payler Donald, Castle Museum, Norwich
1926 Payne T. P. H., Rede Rectory, Bury St. Edmund's
1923 Peed John, Aylsham
1924 Pelham Miss Thursby, Gunton Cliff, Lowestoft
1926 Percy Lord William, Catfield Hall, Norwich
1903 Petre Col., Westwick Hall, Norfolk
1925 Petrie Mrs , The Dower Hou e, Heydon, Norwich
1872 Pigott Sir T. Digby, C.B., F.R.G.S., Sheringham, Norfolk
1926 Phillipps G., 7, St. Philip's Road, Norwich
1925 Pilch R. G., 3, Brigg Street, Norwich
1923 Pope Dr. G. Stevens, Heigham Hall, Norwich
1880 Preston A. W., F.R.Met.Soc., Christ Church Lodge, Norwich
1919 Preston Sir E., Bart., Beeston Hall, Norwich
1900 Preston F., Thorpe Mansions, Norwich
1913 Purdy T. W., Woodgate, Aylsham
1925 Purnell Mrs. Ralph, 9, The Crescent, Norwich
1925 Purnell Ralph, 9, The Crescent, Norwich
1887 Pycraft W. P., A.L.S., F.Z.S., British Museum (Natural History), London, S.W.

R

1925 Reeves Hugh, Honingham Hall, Norwich
1924 Richmond H. W., F.R.S., King's College, Cambridge
1925 Ringrose B., Wilford Rise, Bro neswell Heath, Woodbridge
1924 Rippingall Neale F., Langham, Blakeney, Norfolk
1911 Rising A. P., The Manor House, Ormesby, Great Yarmouth
1908 Riviere B. B., F.R.C.S., F.Z.S., M.B.O.U., Poringland, Norwich
1919 Robinson F., Watton, Norfolk
1869 O.M. Robinson H. S., Eaton, Norwich
1908 Rogers Commander F. S., R.N., Ingham New Hall, Norfolk
1909 Rogers Rev. Henry, Colnishall H l , N rwich
1884 *Rosebery The Right Hon. the Earl of, K.G., 38, Berkeley Square, W. 1.
1908 *Rothermere Rt. Hon. Lord, Hemsted Park, Cranbrook, Kent
1897 *Rothschild Rt. Hon. Lord, F.Z.S., Tring, Herts.
1922 Rounce G. H., The Pines, Park Road, Cromer
1879 Royal Microscopical Society, President of the, *Hon. Mem.*, 20, Hanover Square, W.

Elected

1918 Rudd A. J., F.Z.S., London Street, Norwich
1902 *Ruggles-Brice Mrs. R., Dar-es-Salaam, East Africa
1906 Rumbelow P. E., 27, Rodney Road, Great Yarmouth
1919 Russwurm Mrs., Scarning Grange, E. Dereham
1901 Rye Walter, 66, Clarendon Road, Norwich

S

1925 Sewell P. E., Dudwick House, Buxton, Norwich
1925 Sexton K. F., 156, Newmarket Road, Norwich
1922 Shepheard Dr. Samuel, Aylsham
1924 Shepherd Miss A. M., Convalescent Home, Lowestoft
1921 Silcock Chas., 56, Southwark Bridge Road, London, S.E.1.
1919 Simpson F. T., Sheringham, Norfolk
1917 Smalley F. W., " Hawthorns," 193, Clapham Road, S.W. 9
1919 Smith Col. H. F., Didlington Hall, Norfolk
1915 Smith Mrs., Ellingham Hall, Bungay
1891 Smith W. R., Harleston, Norfolk
1909 Snow T., The Craig, Windermere
1917 Sowels Miss, Thetford
1911 Spurrell J. T., Manor House, Newton St. Faiths, Norwich
1923 Spurrell Miss M., Manor House, Newton St. Faiths, Norwich
1923 Spurrell Miss P., Manor House, Newton St. Faiths, Norwich
1922 Spalding G., 9, St. Stephen's Street, Norwich
1925 Steers J. A., St. Catharine's College, Cambridge
1921 Stimpson Edward, Sall Moor Hall, Reepham, Norfolk
1922 Sumpter Dr. B. G., Brancaster Staithe, King's Lynn
1896 Sutton W. Lincolne, F.I.C., Eaton, Norwich

T

1921 Taylor Dr. Mark R., 49, Mount Pleasant, Norwich
1921 Taylor Mrs. Mark, 49, Mount Pleasant, Norwich
1878 Taylor Shephard T., M.B., The Mount, Edgefield, Melton Constable
1921 Thain D., West Somerton, Norfolk
1886 Thouless H. J., " Corfe," College Road, Norwich
1910 Ticehurst C. B., M.B.O.U., 46, London Road, N. Lowestoft
1896 Tillett Wilfrid S., 2, Claremont Road, Norwich
1920 Todd Lt.-Col. Eardley, Mundham House, Brooke
1902 Todd R. A., B.Sc., Retreat, Elburton, Plymouth
1913 Tomes Sir Chas., LL.D., F.R.S., Mannington Hall, Norfolk
1923 Tomes Lady, Mannington Hall, Norfolk
1923 Torbell C. J., 11, Essex Street, Norwich
1910 Tracy N., 3 King Street, King's Lynn
1925 Tucker B. W., 3, Park Crescent, Oxford
1906 Turner Miss E. L., F.Z.S., H.M.B.O.U., 13, Storey's Way Cambridge

U

1923 Upcher Rev. E. C. S., Great Dunham Rectory, Norfolk
1921 Upcher H. E. S., The Gables, Upper Sheringham

V

1880 Vaughan Matthew, The Limes, Marlborough
1917 Vincent James, Hickling, Norfolk

W

1921 Wallis Rev. M. C., The Vicarage, St. Faiths
1875 Walter J. H., F.Z.S., Drayton Hall, Norwich
1923 Walter Mrs. Cyril, Old House, Drayton, Norwich
1921 Walton Miss, 17, Camberley Road, Norwich
1923 Waterfield Mrs., Attlebridge, Norfolk

Elected

1923 Waterfield Miss, Attlebridge, Norfolk
1923 Waterfield Miss Penelope, Attlebridge, Norfolk
1926 Wemys Major, "Bryn coed," Wroxham
1923 Wenn Mrs., Ingham, Norfolk
1923 Wenn Miss, Ingham, Norfolk
1883 *Whitaker Joseph, F.Z.S., Rainworth Lodge, Mansfield
1901 Wild Edward, The Hawthorns, Eaton, Norwich
1922 Willett W. L., The Rosary, Metfield, Kent
1913 Williams Miss Margaret, 28, The Close, Norwich
1909 Witherby H. F., M.B.E., F.Z.S., 326, High Holborn, W.C.
1924 Wolsey Noel G., 15, King Street, Great Yarmouth
1923 Woolsey G. E. W., Judge's Walk, Norwich
1907 Wormald Hugh, M.B.O.U., Heathfield, East Dereham
1922 Wortley Francis, "Congham," Sheringham
1924 Wright B. D. Z., Hoveton St. John, Norwich
1920 Wyllys Hugh, "Shrublands," Southtown, Great Yarmouth

Y

1923 Young The Right Honble. Lieut.-Com. E. Hilton, D.S.O., M.P., 174, Buckingham Palace Road, S.W.
1915 Yarmouth Free Library, The, Great Yarmouth

TOTAL

Honorary Members	..	...	7
Life	,,	...	... 31
Ordinary	,,	...	... 379
			417

JUNIOR BRANCH

Barclay Miss H., Tittleshall Rectory, King's Lynn
Barclay Miss P., The Warren, Cromer
Barclay Peter, The Warren, Cromer
Barclay Thomas, The Warren, Cromer
Barrett Reginald, 12, Beatrice Road, Thorpe Hamlet
Barry Miss E., Great Witchingham Hall, Norwich
Barry Miss N., Great Witchingham Hall, Norwich
Chamberlain Miss J., Witton Rectory, Norwich
Citters Miss W. van, Wroxham, Norwich
Cole Miss R., Sprowston, Norwich
Cole A. L. F., Sprowston, Norwich
Ferrier Miss J. M., Hemsby Hall, Great Yarmouth
Gurney O. R., Ingham Old Hall, Norwich
Hyslop Gordon, Home Farm, Costessey, Norwich
Lascelles Miss S., Swanton Novers, Melton Constable
Long Miss E., 31, Surrey Street, Norwich
Morrison Miss E., Barmer Hall, King's Lynn
Morse Miss R., Earlham Lodge, Norwich
Parker Miss P., Marlingford, Norwich
Upcher Miss, Dunham Rectory, King's Lynn
Upcher Miss R., Dunham Rectory, King's Lynn
Walter Miss E., Drayton Old House, Norwich
Waterfield Miss B., *Hon. Sec.*, Attlebridge, Norwich
Waterfield Miss Penelope, Attlebridge, Norwich
Waterfield, Miss Philida, Attlebridge, Norwich
Wathen R., Bolwick, Marsham, Norwich
Wathen M., Bolwick, Marsham, Norwich

The Treasurer in Account with the Norfolk and Norwich Naturalists' Society, Year Ending April, 1926

I. GENERAL ACCOUNT

Dr.	£	s.	d.
1925–26.			
To Balance on Deposit	65	17	7
,, Subscriptions	195	13	0
,, Sale of "Transactions"	1	2	0
,, Sale of "Flora of Norfolk"	1	13	11
,, Special Publication Fund	22	10	6
,, Payment by W. B. P. F.	13	3	0
,, Interest on War Stock	5	5	4
,, Interest on Deposit a/c	1	12	3
	£306	17	7

Cr.				£	s.	d.
By Balance, April, 1925				14	12	5
,, "Transactions," vol. xii., part i.						
Printing, 480 copies	102	15	0			
Corrections	2	12	6			
Illustrations	34	14	6			
Envelopes and Reprints	6	12	6			
				146	14	6
,, Norfolk & Norwich Library				6	6	0
,, Printing Circulars, etc.				7	13	0
,, Postages				12	0	3
,, Expenses of Meetings				4	7	7
,, Assistant Secretary				5	0	0
,, Cheque Book				0	5	0
,, Locks to Library book-cases				1	0	0
,, Museum Centenary Fund				2	2	0
,, Insurance				0	13	6
,, Balance on Current a c				38	13	6
,, ,, Deposit a c				67	9	10
				£306	17	7

Examined and found Correct,
W. A. NICHOLSON,
May 26th, 1926

II. SPECIAL PUBLICATION FUND

1925-26.	£	s.	d.		£	s.	d.
To Donations—							
R. J. Colman	10	0	0	Transferred to General Account	22	10	6
Dr. Hutchinson	2	12	6				
Dr. Sumpter	2	2	0				
Mrs. Ruggles Brise	2	2	0				
Sir Eustace Gurney	1	1	0				
E. W. Wild	1	0	0				
R. Gurney	1	0	0				
Dr. Hinde	0	10	0				
J. B. Forrester	0	10	0				
Sums under 10s.	1	13	0				
	£22	10	6		£22	10	6

BRITISH MUSEUM 26 JAN 27

III. LIFE MEMBERSHIP FUND

1925-26.	£	s.	d.		£	s.	d.
To Balance in Savings Bank, April, 1926	44	5	7	By Interest transferred to General Account	5	5	4
,, One Life Member	8	0	0				
,, Interest on Bank Account	1	2	1				
,, Interest on War Loan	5	5	4	,, Balance in Savings Bank	53	7	8
	£58	13	0		£58	13	0

Investments and Assets, April, 1926

	£	s.	d.
64 War Savings Certificates, dated 24.1.19	64	0	0
5 per cent. War Stock 1924–47 at cost	100	0	0
31 War Savings Certificates, dated 17.7.23, at cost	24	16	0
Balance in Savings Bank	53	7	8
	£242	3	8

ADDRESS

Read by the President, E. Hanbury Hankin, M.A., Sc.D., *to the members of the Norfolk and Norwich Naturalists' Society, at their Fifty-Seventh Annual Meeting, held at the Norwich Castle Museum, on April 27th,* 1926.

Ladies and Gentlemen,

If the increase in the membership of a society is a guide to its prosperity and usefulness, then, I think we may say that the past year has been one of success for the Norfolk and Norwich Naturalists' Society

During the year we have lost four members by death, namely : Lady Boileau, Mr. Euren, Dr. Hancock, and Mr. E. T. Roberts ; and so far, the Honorary Secretary has received notifications of but two resignations. We have elected twenty-six new members, so that our membership has been increased by twenty, and now stands at 422, the highest in the history of the Society.

Our monthly meetings have been unusually well attended, and the last Number of our Transactions has maintained the high standard we have set ourselves in former years. The last three volumes of these have been edited by Dr. Long, who, through pressure of other work, hands over these editorial duties to-day to Mr. Robert Gurney.

I now pass on to the subject of my address which is

THE EVOLUTION OF FLYING ANIMALS

If learning to fly is difficult for men, aided as they are by scientific knowledge and petrol motors, how, it may be asked, did nature succeed in evolving flying animals who at first, must have lacked muscles, organs, and instincts adapted for the purpose ? Further, if jumping through the air led to gliding, how, it may be asked, did gliding lead to true flying with the power of flapping flight and of steering and control while in the air ?

We have to turn to geologists in seeking an answer to this question.

It is probable that the earliest flying creatures were insects. The larvæ of certain primitive insects, such as mayflies, carry on each joint of the abdomen a pair of flat plates known as

" tracheal gills." One theory of the origin of the wings of insects is that they were derived from such tracheal gills. Another theory is that wings were developed from " paranotal " expansions on the thorax. This latter theory offers no explanation as to how or why the expansion became mobile, or how the muscles for flapping flight originated. The former theory presupposes that the tracheal gills could be waved up and down for the sake of aeration, and such movement might gradually lead to flapping. It has been suggested that in some early Palæozoic period, certain small ancestral insects were in the habit of leaving the water in which they usually lived, and

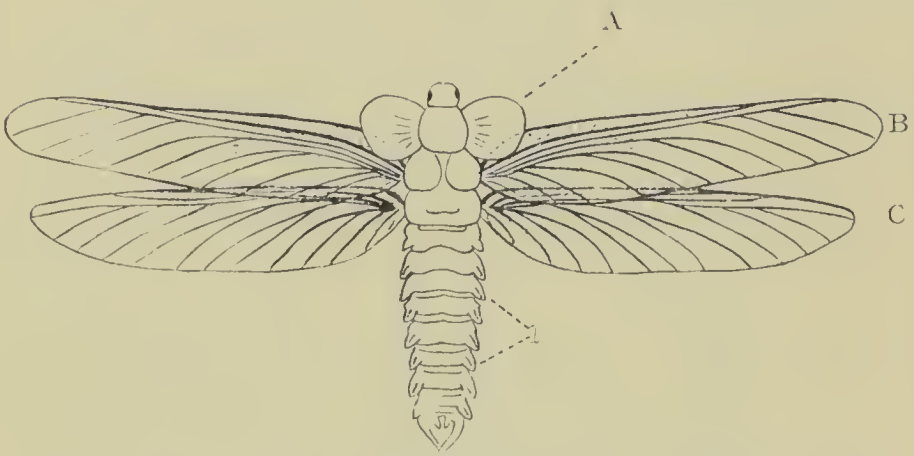

Fig. 1. Restoration of *Stenodictya lobata*, a primitive insect. A, wing of prothorax whose use may have been to depress front edge of B wing of mesothorax. C, wing of metathorax. D, tracheal gills on each joint of abdomen

creeping up the stems of plants, where they sat waving their gills in the air. Nature even at that distant time was already " red in tooth and claw," and occasionally, it is supposed, these insects had to jump off into the water to avoid some enemy. Their gill plates would give them a certain amount of gliding support. Those insects who had the largest plates could glide furthest and, if this was an advantage, their survival might lead to the evolution of wings. The change would be most likely to affect those gill plates that were nearest the centre of gravity of the body, namely, those on the three joints of the thorax. A very remarkable fossil insect has been discovered that represents an actual stage in this process of evolution. Its name is *Stenodictya lobata* (Fig. 1). It had six wings, one pair being

attached to each of the three joints of the thorax. The first pair of wings were small, and no doubt destined shortly to vanish in the course of evolution.

As shown in the illustration, the eyes of this insect were lateral and therefore ill-adapted for seeing ahead, a fact that agrees well with the idea that it was a new-comer in the air, and, further, excludes an alternative suggestion that might be made, namely, that it learnt to fly by chasing its prey rather than by avoiding its enemies.

If the ancestral insect had the power of waving its gills up and down to increase the rate of aeration, there is no difficulty in imagining how a development of this power might lead to flapping flight. How the power of steering from side to side could have orginated is a matter worth consideration.

In Dragon-flies, to which insects *Stenodictya* was probably ancestral, steering to right or left is produced by rotation of one front wing. If a dragon-fly while gliding wishes to turn to the right, it rotates its right front wing. The speed ahead of the two right wings are thereby checked, and the insect makes a rapid turn. The rotation is only momentary and very difficult to see. Its appearance is shown in Fig. 2. To make a gradual

Fig 2. A Dragon-fly seen from behind steering to the right. The right front wing has been rotated

turn, a much smaller amount of rotation would be sufficient. Steering by thus checking the speed of the inside wing is the method employed by all flying animals.*

There are no grounds for assuming that the ancestral insect had any power of rotating its gill plates. Neither, if it had this

*See *Animal Flight* (London, Iliffe & Sons, 1913).

power, is it immediately obvious how it could learn to use it for steering when the gill plates developed into wings. The following guess, however, may be made as to how the power of steering arose, either in *Stenodictya*, if it possessed this power, or at least in its descendants.

The three joints of the thorax were not fused together in this primitive insect, as they are in all modern insects except the fleas. Neither do the remains of this insect give any hint of a neck, such as is present in dragon-flies. The insect when gliding would be likely to turn its head in whatever direction it might wish to go. If this turn of the head was brought about partly by movement of the first segment of the thorax, then the small wings on this segment might tend to press down the front edge of the large wings of the following segment. This pressing down would be a rotation of the kind needed to steer to the side to which the insect was looking. If the insect wished to descend more steeply, we may imagine it would direct its head downwards. Such movement might cause both of the prothoracic wings to press on the front edges of the large wings, causing the adjustment suitable for increased rate of descent. Thus it may be suggested that the wings of the prothorax were retained in a reduced condition in *Stenodictya*, not because they were of any direct use for support in the air, but because they furnished a makeshift means of control until muscles for rotating the main wings could be evolved.

More highly developed precursors of dragon-flies (*Protodonata*) are found in Carboniferous strata. One of them had a span that exceeded two feet. Another descendant of these primitive insects from Australia with a span of about six inches, had wings so long and narrow that it is difficult to believe that it was capable of anything except very gentle flapping. It seems more likely that, like many dragon-flies of to-day, it was an adept in soaring flight.* Dr. Tillyard, its discoverer, has given it the appropriate name of *Aeroplana mirabilis*, taking it as the type of a new order of insects the *Aeroplanoptera*.†

*" The soaring flight of dragon-flies," *Proc. Camb. Phil. Soc.*, Vol. XX., Part 4, p. 460.

†" Mezozoic Insects of Queensland, No. 3, Odonata and Protodonata," by R. J. Tillyard (*Proceedings of the Linnean Society of New South Wales*, Vol. XLIII., Part 3, August 28th, 1918.

No great difficulty is presented by the problem of the evolution of flight among fishes. Many fishes scuttle along the surface of the water to avoid their enemies. This mode of motion may be aided by jumps into the air during which the pectoral fins, however small, will aid in support. Every stage in the enlargement of these fins, till they can act as wings, is likely to be of use to its possessor. At the present day fishes belonging to several different families have the power of flying. Hence this power has been evolved independently by fishes on many occasions in the course of their evolution.

In the earliest undoubted flying-fish, *Thoracopterus Niederristi*, from Upper Triassic strata, as shown in Fig. 3, it may be

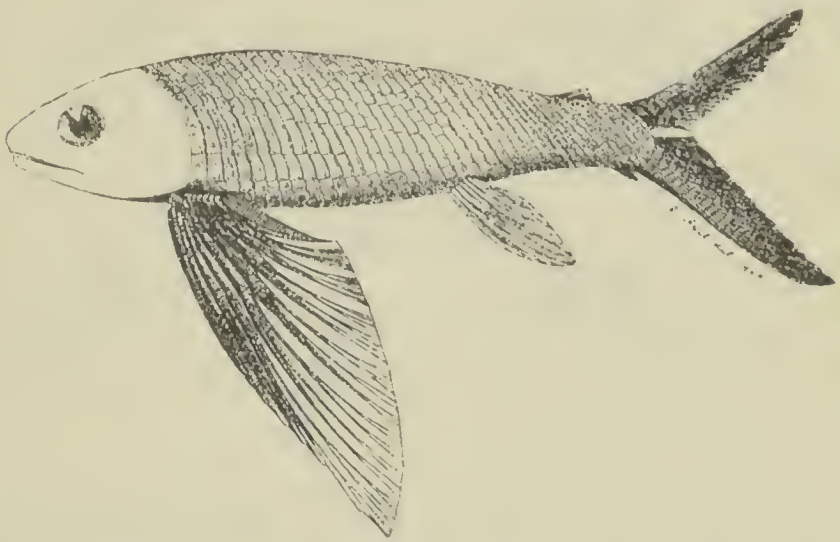

Fig. 3. Flying-fish, *Thoracopterus Niederristi*, from Upper Triassic (Abel) (after Zittel)

noted that the enlarged pectoral fins or wings are attached to the lower part of the body, and are therefore below the position of the centre of gravity. Such an arrangement is unusual in flying animals, and, one may suspect, would be liable to lead to lateral instability. In the modern flying-fish *Exocoetus* Fig. 4, the wings are attached on a higher level than the centre of gravity. But in a less perfect flier, the fresh-water flying-fish *Pantodon*, the wings are also in the lower position as in *Thoracopterus*. A proof that *Thoracopterus* had the power of flight is given by the fact that, as shown in the illustration, the lower lobe of the tail is enlarged. Such enlargement is present in the

modern flying-fish *Exocoetus*, and also in another fossil flying-fish *Gigantopterus*.

When starting a flight *Exocoetus* does not jump out clear of the water as a rule. It only emerges by a jump so far that the front wings are clear of the water and at once are expanded. The tail is then wagged vigorously to and fro, and thus, by sculling action (for which the enlargement of the lower lobe is helpful), increases the speed till suddenly the fish is drawn up into the air and remains in gliding flight with its wings at rest and sometimes, for a distance of several hundred

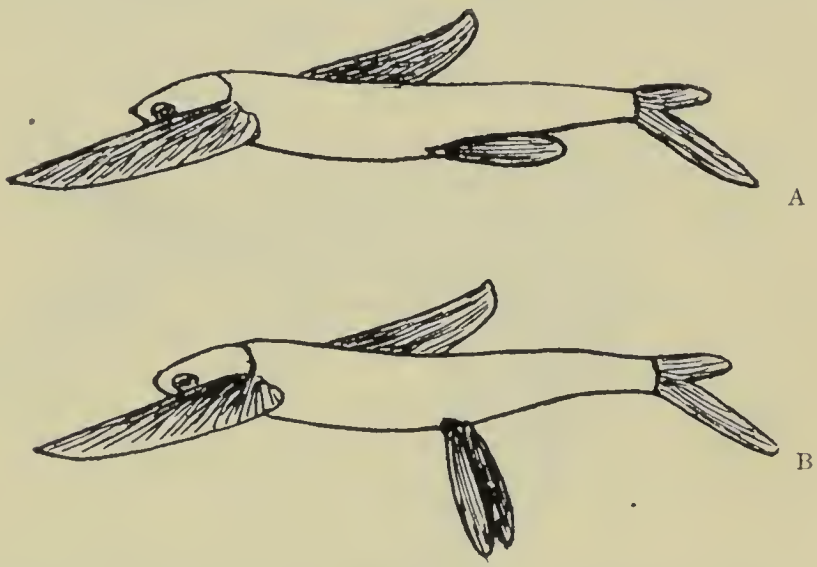

Fig. 4. The Common Flying-fish, *Exocoetus*, at A, with its wings in the po ition used in high speed flight. At B the pelvic fins are shown directed downwards to act as a brake and check speed before plunging into the water. In the monsoon wind, in which flying-fishes may attain enormous speeds, these fins may thus be directed downwards from near the start to the end of a flight. Another method of checking speed, described elsewhere, is used in connection with slow speed flight.

metres, preserves a uniform height above the water. Occasionally, especially in cooler weather, slight fluttering of the wings does occur at starting, but the wings are nearly always at rest during the remainder of the flight. As the flight is usually only a few inches above the water surface it occurs in a position where it is difficult to invoke the presence of strong ascending currents to explain it. Weak ascending currents or masses of warm air mixed with masses of cooler air are perhaps likely to be present to a greater extent than usual

during the monsoon in the Arabian Sea when the longest and fastest flights have been observed by me.* (Fig. 4.)

The weight of the flying-fish is about eight times as great as that of a bird of similar size. Hence, if its flight was due to undetected flapping, one would expect that the muscles for moving the wings would be very strongly developed. As a matter of fact they are at least five times smaller than those of a bird according to measurements given by Moebius.

An example of a flying-fish whose flight depends solely on flapping is given by the small fresh-water flying-fish *Gastropelecus* (Fig. 5). The under surface of its sternum is developed

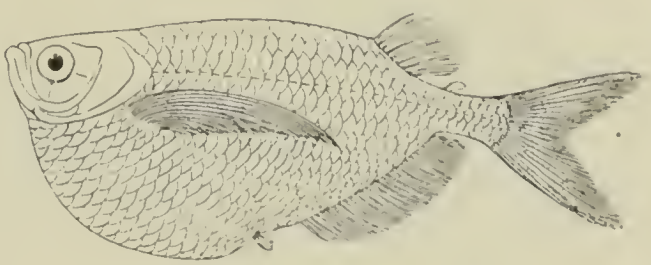

Fig. 5. *Gastropelecus sternicla*
(from British Museum Special Guide No. 6)

into a deep, narrow keel to which the flight muscles are attached. (Fig. 6.) These muscles are said to amount to one quarter of the whole weight of the body. The similar muscles of a bird, according to a measurement by Moebius, are less than one-sixth of the weight of the body. In its flight *Gastropelecus* is said to dart along the surface of the water with only its keel immersed and with its wings in rapid movement. After proceeding thus for some such distance as forty feet it emerges completely for a yard or two, and then falls back into the water.†

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*See "Geological History of Flying Vertebrates," by G. W. Young, *Proc. of the Geologists Association*, Vol. XXVI., Part 4, 1915, p. 229.

†See "Observations on the Flight of Flying Fishes," *Proc. Zool. Soc. of London*, December, 1920, p. 467, and "Flying Fishes and Soaring Flight," *Proc. Camb. Phil. Soc.*, Vol. XXI., Part 4, November ,1922, p. 421.

Thus the flapping flight of *Gastropelecus* involves strong muscular exertion, and is far less effective than the soaring flight of *Exocoetus*.

In Fig. 6 is shown a supposed fossil flying-fish, *Chirothrix libanicus*, from the Upper Cretaceous strata of Mount Lebanon. It probably had no power fo flying because (1) In flight the greatest pressure on a wing is near its anterior border. Hence this border is always strengthened except in some of the minutest flying insects. No such strengthening is shown by the supposed wing of *Chirothrix*. And (2) There is no enlargement of the lower lobe of the tail as is found in *Exocoetus*. It may be noted that the supposed

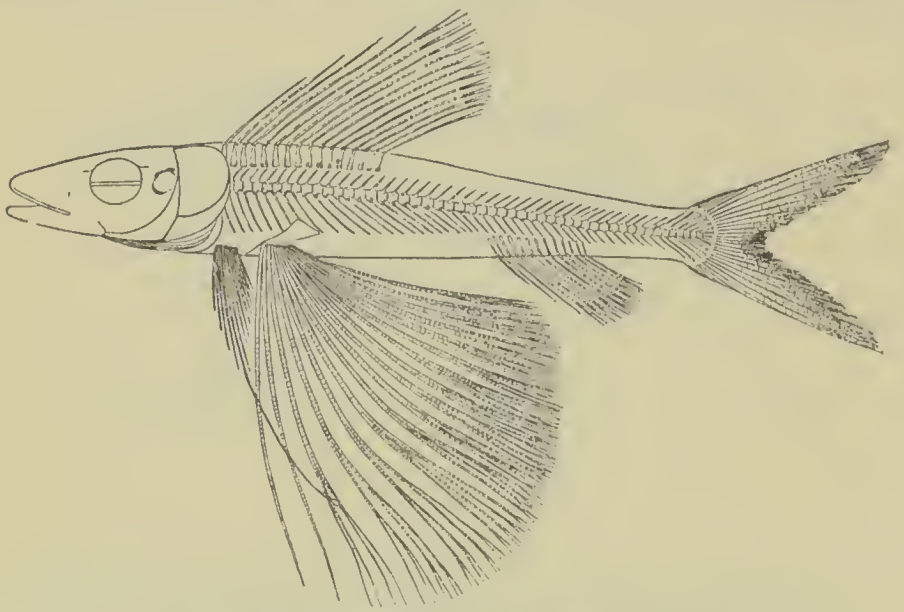

Fig. 6. *Chirothrix libanicus*, a supposed Flying-fish from Upper Cretaceous (after Smith Woodward)

wing is not an enlarged pectoral fin, but is the pelvic fin which has been shifted forward from its primitive position. The pectoral fin is small and supplied with a long filament.

There can be no doubt that gliding with loss of height is the most primitive form of movement through the air. It is possible to make a suggestion as to why certain animals have remained at this primitive stage and have failed to evolve further and to acquire the power of flapping flight. Before doing so, let us briefly recapitulate the known instances of creatures which glide in this manner :—

(1) The Flying Lizards (*Draco*) of Southern India and the Malay Peninsula and Archipelago are furnished with lateral expansions

of the body supported on five or six greatly elongated ribs. They live on trees and eat ants. They often make glides of forty to fifty metres in length but always with a loss of height of about one in four. The anterior margin of the wing is formed by two closely apposed ribs and a small amount of muscular tissue. There are also muscles for advancing and retiring the wings. The action of these muscles in altering the camber or the disposition of the front portion of the wing is probably the source of the slight power of steering while in the air that these lizards are asserted to possess.*

(2) The Flying Phalanger (*Petaurus*), a Marsupial from Australia, lives in trees and can glide from branch to branch by a lateral skin extension which is supported by the fore and hind limbs. Aeronautical authorities tell us that any increase in span of such a surface (the so-called "patagium"), that is in its extent from side to side, must be of much greater value for gliding than an increase in its length. In the remaining gliding animals to be mentioned we see what may be described as efforts of different kinds to increase the span.

(3) In the Flying Lemur (*Galeopithecus*) an increase of span of moderate amount is obtained by a lengthening of the limb bones.

(4) In the African Flying Squirrel (*Anomalurus*) a rod of cartilage grows out from the elbow joint and aids in supporting the patagium.†

(5) In the Asiatic Flying Squirrel (*Petaurista*), there is also a rod of cartilage, but this is attached not to the elbow but to the wrist.

So far as is known to me, flying squirrels lack the power of steering from side to side when making a glide. It is not easy to see how they could discover that any steering action could be produced by movements of the tail; neither is it likely that such movements could have any marked effect unless the tail was greatly expanded in the vertical plane. No instance is known to me of a steering action of the tail in any flying animal. If the tail was used for this purpose its action would need to be accompanied by a change of disposition of

*Animal Flight, p. 358.

†British Museum (Natural History) *Guide to Specimens illustrating Flight* (1913), p. 12.

the wings in order to produce the canting or banking that is needed for an efficient turn.

Let us consider the means of steering employed by birds. In Fig. 7 is shown the bones and wing-tip quill feathers of the wing of a bird. The bony skeleton contains the remains of three digits, two of which are often furnished with minute claws. These are vestiges of claws that were functional in their reptilian ancestors. Thus the outer part of the wing or " wing-tip " is attached to the wrist joint which is capable of being rotated.

Rotation of the wing-tip by movement at the wrist joint is used by the bird in steering. If a gliding bird wishes to turn to the right, the wing-tip of the right wing is rotated in such a sense that the front edge (or " leading edge ") of the wing-tip descends. This causes resistance to movement ahead. The

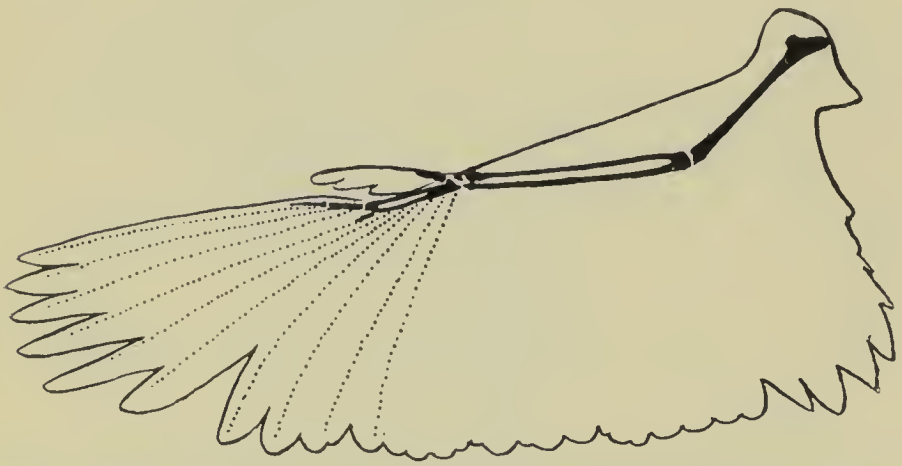

Fig. 7. Wing of Adjutant bird. The wing-tip quill feathers, which are used for steering, shown as dotted lines

speed of this wing-tip is reduced and the bird accordingly turns. Thus the inclusion of the wrist joint in the structure of the wing is the reason why birds were able to acquire adequate methods of wing control while in flight.

In bats, as with the flying squirrels, there has been a tendency for the patagium to spread laterally. But with these animals the patagium spread between the fingers and the fingers lengthened to such an extent that they support a considerable part of the wing surface. There is a muscle that can bend downwards the outer part of the wing by movement at the wrist joint, and my observations indicate that such movement is used by bats for steering.

In the Pterodactyls the wrist joint was also involved in the wing, and, as will be described below, there is reason for thinking that their powers of flight were highly developed.

In the Flying Lemur, *Galeopithecus*, the patagium, besides fringing the body, is extended between the fingers and the toes. But there is no lengthening of these digits. Consequently only an insignificant fraction of the patagium could be controlled by movements of the wrist joint.

Thus the accident that the wrist joint was not included in the patagium so that it could control the disposition of the outer part of the wing appears to offer a reason why the power of movement through the air of flying squirrels has not progressed beyond the gliding stage.

As regards the mode of origin of birds, Abel has suggested that the ancestral reptile was one that had a habit of running on its hind legs, and that it used its arms as balancers, and that outgrowths on the arms gradually developed into feathers.* Three objections may be brought forward against this idea. First, the habit of running would tend to cause an increase in the size of the legs and accordingly to bring backwards the position of the centre of gravity. To produce a bird, on the contrary, what is required is to bring the centre of gravity forward until it is under the position of the centre of lift of the wings. Secondly, the animal would be a very poor runner, to start with, to need to use its arms as balancers at all, and, on the principle of the bicycle, the faster it ran the less it would need them. Thirdly, the outgrowths of the skin destined to become feathers would have to undergo a long course of development before they could be of appreciable use in flight.

It is far more likely that the ancestors of birds were tree-frequenting in habit, and that they learnt to glide by jumping from bough to bough.

Another suggestion has been made by several writers as to the origin of feathers. Mammals are warm-blooded animals of cold-blooded reptilian ancestry. They have developed a covering of hair to keep in the heat. Is it not possible that feathers also were primarily developed to keep in the heat,

*" Die Vorfahren der Vögel und ihre Lebensweise," *Verhandlungen der K. K. Zoologisch-Botanischen Gesellschaft in Wien*, Vol. LXI. of 1911, Parts 3, 4, 5 and 6, p. 144.

birds being also warm-blooded in habit? Even the smallest down feathers would be of use for this purpose. Every increase in size would make them more useful in this respect, and, at length, we may imagine, some of the feathers enlarged still further and became of use for gliding flight.*

Thus we are led to the conception that a particular stage in the ancestry of birds was represented by a warm-blooded tree-frequenting reptile that had a covering of feathers some of which were enlarged so as to be capable of giving gliding support. Its gliding must have been with strongly marked loss of height. It had no power of steering while in the air. It had an elongated lizard-like body. Consequently, its centre of gravity must have been not far in front of the pelvis. Hence the feathers on the wings must have been balanced by a corresponding development of feathers on the tail. The front limb had a hand furnished with three functional claws.

Reconstructions of the fossil bird *Archaeopteryx* usually represent it as bipedal in habit like a modern bird. But a paper by Hans Steiner,† contains a reproduction of the supposed reptilian ancestor of birds, showing a creature with lizard-like body (Fig. 8). That *Archaeopteryx* had closer resemblance to this hypothetical "Pro-Avis" than is commonly supposed is made probable by the following considerations :—

(1) In Fig. 9A, a diagrammatic reconstruction of *Archaeopteryx* is shown which has been made with the help of careful measurements taken from photographs of the Berlin specimen. It will be seen that its body, instead of being shortened as in birds, was long like that of a lizard. That its centre of gravity was not far from the point marked CG is made probable from the following considerations. A copy of the outline shown in Fig. 9A was cut out in thin sheet aluminium. By experiment it was found that the centre of pressure against an air current directed at right angles to the surface was about on the level with the hip joint. In gliding flight with a small angle of incidence the centre of pressure would be brought forward. It must have coincided with the position of the centre of gravity, and on any probable assumption of the position of the wings

*This suggestion was put forward by me in a paper entitled "The Development of Animal Flight," in *The Aeronautical Journal*, January, 1912, p. 24

†"Das problem der Diastataxie des Vogelflügels" (*Jenaische Zeitschrift*, Vol. 55, p. 221, 1918).

in gliding flight can not have been far from the point marked CG. Thus its centre of gravity was aft of the position of the lift of the wings and balance must have depended on aid from support given by the tail. A very different state of affairs is the case with a slow-flying bird such as *Neophron percnopterus* of which a diagram is represented in Fig. 9B. Here the centre of gravity CG, found by experiment on the dead bird, is at a point corresponding with the position of lift of the wings, and the tail plays no appreciable part in support.

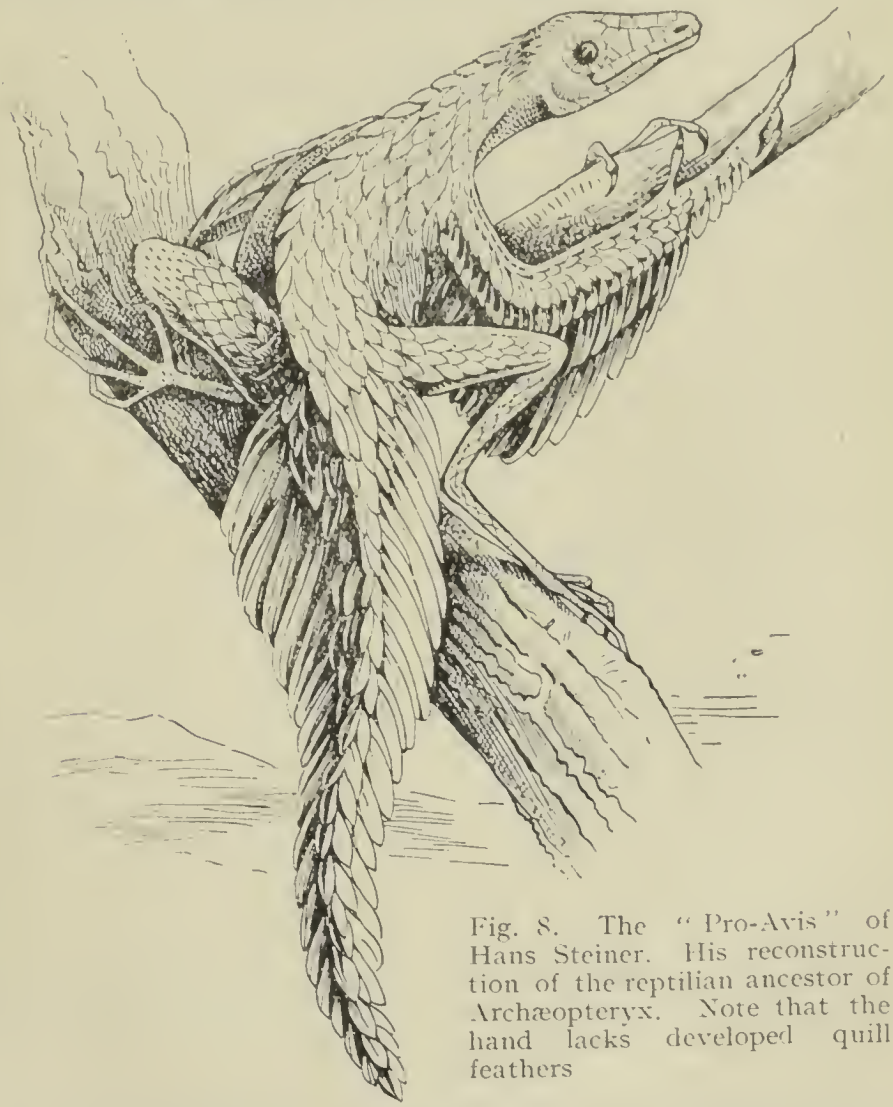

Fig. 8. The "Pro-Avis" of Hans Steiner. His reconstruction of the reptilian ancestor of Archæopteryx. Note that the hand lacks developed quill feathers

(2) The diagram of *Neophron* is drawn of such a size that the distance from the shoulder joint to the hip joint is the same as in the diagram of *Archaeopteryx*. If this distance is taken as the unit, the span of *Archaeopteryx* is less than five units while the span of *Neophron* is over twelve units.

(3) In the two diagrams the shafts of the primary quills of the right wing are indicated by dotted lines. In *Neophron* the disposition of these quills is affected by rotation of the wrist joint. It is by such rotation that the bird steers itself to right or left. In *Archaeopteryx* the primary quills are less in number and, as compared with *Neophron*, form but a small fraction of the supporting surface. Thus it cannot have had more than very restricted powers of steering from side to side when in gliding flight.

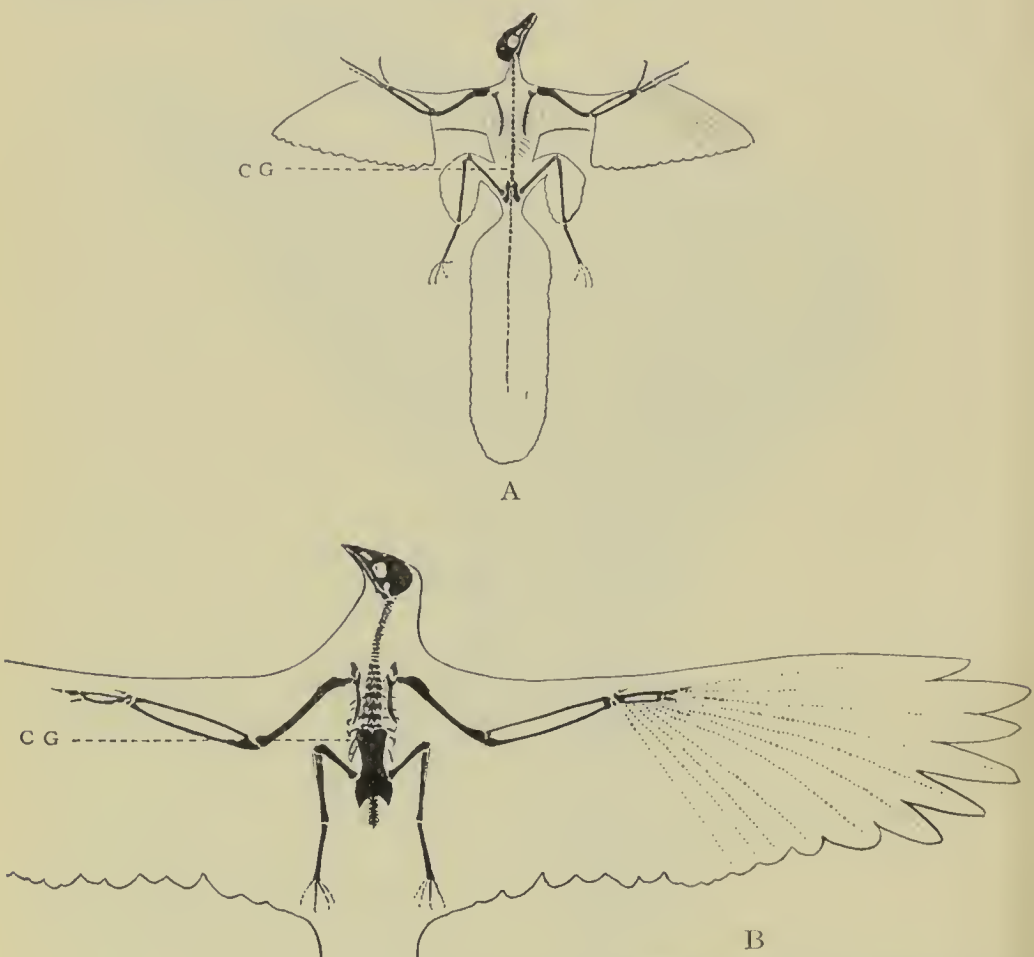

Fig. 9. Diagrammatic reconstruction of Archæopteryx (A) and similar drawing of a modern bird (B) C G centre of gravity

(4) Steiner's researches show that *Archaeopteryx* had seven primary quills, as compared with nine to eleven in existing birds. It is probable that the missing quills are those at the beginning of the series (i.e., the distally situated quills), because these quills are the last to develop in embryo birds. Also

these quills remain undeveloped in the Hoatzin so long as the claws of digits I. and II. remain functional. Thus it is likely that the claws of *Archaeopteryx* were free and had no duty to perform in supporting quill feathers. Heilmann has given reasons for believing that the metacarpals and basal phalanges of digits II. and III. were attached to each other by ligaments so that they could act better as a support for the quill feathers, but his illustrations (Figs. 17 and 72 in his book, *The Origin of Birds**) suggest that the metacarpal of the first digit was as mobile as that of the young Hoatzin.

(5) In many existing species of birds, digits I. and II. terminate in minute claws that are hidden in the feathers. But in the nestling of the Hoatzin or "Quadruped Bird" from South America, these two claws are well developed and used for climbing about the branches of the tree in which the nest is placed. Pycraft describes this habit as being "handed down from the dawn of avian development." It seems difficult to hold this opinion and yet to deny that the claws of the hand of *Archaeopteryx* were, at least to some extent, functional.

(6) The base of each claw has a protuberance for attachment of a flexor muscle. In the claws of the hand these protuberances are larger than in the case of the foot, a fact difficult to reconcile with the view that these claws were not in use.

(7) In the first four or five primary quills of birds the part of the vane in front of the shaft is much smaller than the part that lies behind it. When in the air these feathers, in such birds as vultures, are held almost at right angles to the line of flight. Hence the shaft is at the position of greatest pressure. There is no such great difference in the two parts of the vane of the primaries of *Archaeopteryx*, a fact that tends to justify the wing disposition shown in the diagram and to support the suggestion that the claws were not embedded in the feathers but exposed.

In modern birds the first digit—the *alula*—carries a small tuft of stiff feathers. These feathers contribute no doubt to the strength and shape of the anterior border of the wing. Slight movements of the alula may be seen when the bird is checking speed in the air preparatory to alighting. These

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*Published by Witherby, London, 1926.

movements have been observed by me in birds of three different species. The alula is so small and its range of movement is so limited that it is rather difficult to believe that this movement can have any appreciable effect either in checking speed or in maintaining equilibrium. Such movement of the alula may be observed both when the bird is dropping feet foremost through the air with partially furled wings and also in what has been termed by me "stop descent," when the bird is landing with its wings fully extended and with their surface nearly at right angles to the direction of flight. That movements of the alula accompany two such different wing dispositions is a reason for doubting whether they have any significance from the point of view of flight. The movement is either advancing or advancing combined with rotation up. Sometimes, instead of keeping the alula in one position, the bird keeps moving it to and fro while descending. This appears to be a further reason for doubting the utility of the movements in question.

Is it not possible that this change of position of the alula during descent is a habit "handed down from the dawn of avian development," and that in fact *Archaeopteryx* thus extended its first digit when springing on to its prey?

An observation described on page 135 of my book, *Animal Flight*, might possibly be regarded as evidence against this suggestion. An Adjutant, a bird of more than nine feet span, was noticed while circling to have the alula of the inside wing advanced. The extent of this movement was perhaps a little more than half an inch. Such change of position of the alula in circling is quite exceptional. Perhaps in this case it was an accidental accompaniment of a movement of the next digit, i.e., of the phalangeal quill mass, which may have been needed to keep the bird on a curved course.

According to Abel, *Archaeopteryx* flew with the palm of the hand facing forward and not with the palm horizontal, as in living birds. This must have been the case if it had a habit of springing like a quadruped from bough to bough in trees, as otherwise the primary quills would strike the branch on which it alighted.

Thus we see that there are various more or less cogent reasons for thinking that *Archaeopteryx* resembled the hypothetical

gliding ancestor of birds much more than is commonly supposed. Evidence available does not seem sufficient to justify a definite opinion as to whether it could steer while in the air or whether it had acquired the power of flapping flight. Such abilities, if possessed at all, must have been much less developed than they are in modern birds. It will be of interest to consider how these abilities could have been acquired.

It has been observed by me that if a gliding bird is about to make some large change of wing disposition in order to effect some change in its flight, it often makes several small movements of its wings of the same nature as, and in anticipation of, the large movement that is about to occur. These " anticipatory movements " are far too small to have any visible effect on the direction of flight, nevertheless they have occasionally enabled me to understand or to foresee various flight manœuvres.* Now, supposing *Archaeopteryx*, while gliding, were to make anticipatory movements of its hands before seizing its prey in its claws, such movements, if in a fore and aft direction, would have tended to steer the bird up and down and therefore to check its speed. Such movements, if in an up and down direction, on the other hand, would have tended to aid the speed of the glide and might have led to the discovery of the use of flapping. Supposing its prey was an insect which, when alarmed, began to run away ; suppose it ran to the right ; the *Archaeopteryx* would be likely to turn its head to the right. It might also advance and lift its left wing and retire and depress its right wing in anticipation of seizing the insect. Such movements would tend to cant and steer it in the desired direction, and might conceivably lead to the methods of control in use by the birds of the present day.

We have now to consider the evolution of the flying reptiles known as Pterodactyls, in which the wing membrane is supported by an enormously elongated finger. The earliest forms had a long tail and an elongated, lizard-like body. Attempted restorations show them as two-winged creatures with the probable position of the centre of gravity far behind the probable position of the centre of lift of the wings, an arrangement that would be quite unsuited for flight. But Stromer

*See *Animal Flight*, pp. 150, 162, 185, 190, and 395.

states that " one of his museum assistants recollects seeing a beautifully preserved specimen of the Pterodactyl *Rhamphorhyncus* in the shop of a dealer some ten years ago, and that this specimen showed a wing membrane supported by the hind leg and passing from the fifth toe of the hind foot to about half way along the tail.* An attempt has been made to explain away this story by the suggestion that some ossified tail tendons from the tail had become displaced and simulated the outline of a hind wing. But, if the story is true, it is more probable that what was seen was really the remains of a hind wing, for the fifth toe of the earliest known pterodactyl was elongated as if to support a wing membrane. It was not provided with a claw as were the other toes. Further

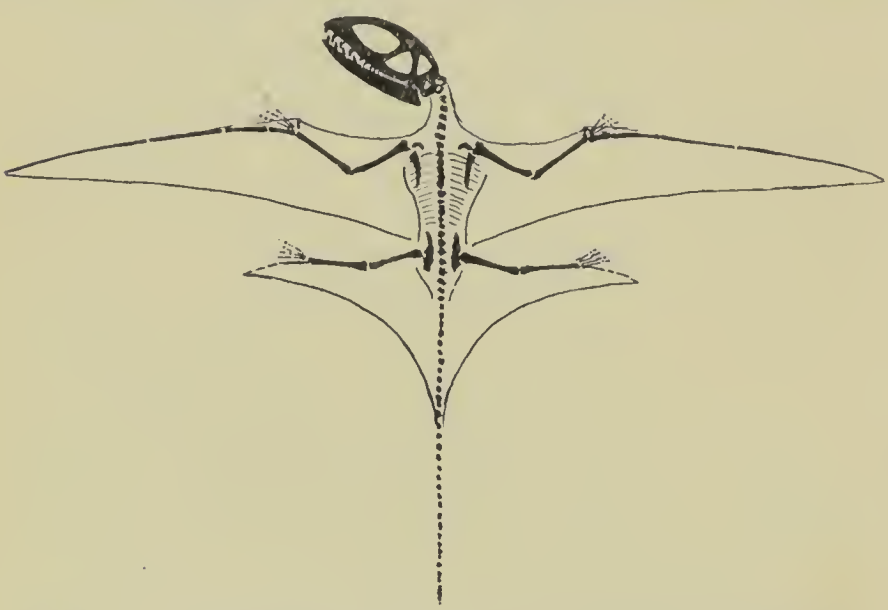


Fig. 10. Diagrammatic restoration of the primitive *Pterodactyl*

in the course of evolution of pterodactyls the fore wings were enlarged while the tail dwindled and the body of the animal was shortened. Hence at length there was no longer any need for a hind wing, and the clawless fifth toe diminished in size or completely vanished. On these grounds a diagrammatic restoration of the earliest known pterodactyl (*Dimorphodon*) is given in Fig. 10. It may be mentioned that the disproportionately large head of this reptile was not so heavy

*" On the flight of pterodactyls," *Aeronautical Journal*, No. 72, October 1914, p. 333 footnote.

as it looks, for it was lightly built and very narrow from side to side.

As regards its powers of flight, *Dimorphodon* had reached a more advanced stage of evolution than *Archaeopteryx*, for, taking the distance from the shoulder joint to the hip joint as the unit, its span was about eight of these units, as against less than five for the latter.

The later pterodactyls were the most remarkable, the most highly specialised and perhaps the most efficient flying animals that have ever existed. The larger species had a span of more than twenty-one feet. (Fig. 11.)

Fig. 11. Restoration by Howard Short of *Pteranodon*, a large pterodactyl, reproduced from *Aeronautical Journal*, Jan., 1912, by kind permission of the Editor

Their mode of life is most puzzling. From the position in which their remains are found, it is deduced by geologists that they habitually flew over the sea at some such distance as fifty to a hundred miles from the nearest land. If so, it seems probable that they must have spent their time over the sea entirely in flight, for the following reason. Their shoulder and elbow joints were hinges that permitted up and down movement only. The outer part of the wing could be flexed at the knuckle joint. Thus, when it had done its best to furl its wings, it still had a span of about ten feet. Hence, except in a perfect calm, it is difficult to understand how it could have

regained the air if it ever settled on the water. As its hind legs were involved in the wing membrane, they were certainly useless for swimming.

Presumably the animal must have landed sometimes. But if it did so, it is difficult to understand how it can have moved about. It could not have walked as a quadruped because, as already stated, no fore and aft movements of the shoulder or elbow joints were possible. Neither could it have walked as a biped, the hind legs apparently not being strong enough for the purpose, and even if the wings were fully extended, when so walking, the wing-tips would probably have dragged on the ground. It might be suggested that when ashore they hung head downwards from a tree as do the large fruit-eating bats. But a flying-fox, for example, when alighting on a tree, has to rotate round its transverse axis so as to bring the hind legs forward so that its toes may seize a twig. It does this by means of vigorous "poise-flapping," and having done so and seized the twig, it suddenly furls its wings and its body falls over to one side or the other.* But the wing muscles of the pterodactyl were certainly too weak for poise-flapping, and it was incapable of furling its wings. It would have had some difficulty in finding a twig strong enough to support its weight of probably about twenty pounds, and at the same time sufficiently isolated from other twigs and branches to avoid risk of breaking the unfurled wings.

Before making a guess as to how these strange animals could have got their food, let us consider their probable mode of flight. Their twenty-one-foot wings had to support a body a little larger than that of a cat. In their structure weight saving was carried to an extreme. The walls of their wing bones were made of hard bone scarcely thicker than a visiting card. They were air-filled except at the ends, where they were strengthened with bony sponge-work of paper-like thinness. The ridge on the breast-bone for attachment of the flight muscles was singularly small. Their whole structure was so obviously adapted for life in the air that it is impossible to conclude from the weakness of these muscles that they flew worse than birds. We must rather conclude that they flew

*See *Animal Flight*, p. 150 and 221

more scientifically, in other words, that they depended on soaring rather than on flapping flight.

Thus the large pterodactyls were more highly specialised for flight than any other known animals. They could fly, but they could neither swim, nor dive, nor walk, nor hop, nor hang from the branches of a tree. The question remains: how could they eat? At first sight the difficulty appears to get greater the more we look at it. Living far out to sea, apparently they could have found nothing else than fish to eat. They were furnished with a mouth and head whose structure indicates that they were fish-eating in habit. But a fish-eating bird plunges into the water to catch its prey. A pterodactyl could not do this without risk of breaking its wings, as they could not be furled and, if it escaped this danger, it is probable that it could only regain the air with difficulty and only in the calmest sea. The great length and consequent fragility of the wing bones make it highly improbable that they could check speed suddenly, after a dive through the air, just before reaching the water—a manœuvre that presents no difficulty to the strongly built wings of kites and vultures. Hence, it is highly improbable that they could have swooped down from a height and checked speed when near the water to catch some unsuspecting fish. It also seems improbable that they could have glided close to the water at such a low speed that they could have snapped at and caught fish that were swimming just below the surface. To do so it would frequently be necessary to steer rapidly to one side or the other. We may confidently say that they could not do so if gliding near enough to the water to catch fish, for, like any other flying animals, if they suddenly steered to one side they would have to cant over. With a spread of wings of twenty-one feet they could only become canted if at such a height above the water that fish would be well out of their reach; otherwise, on making the turn the inside wing would strike the water and the flight would come to an end.

One possibility, however, can be suggested, namely, that their food was flying-fish caught while the latter were gliding through the air. We may imagine that the pterodactyls habitually glided a few yards above the water surface, and that they would swiftly dart down and catch a flying-fish whenever they saw a shoal emerge in front of them. Arguments weakly

supporting this idea, such as the structure of the articulation of the lower jaw of the pterodactyl or the presumed defective vision of the flying-fish while out of water, no doubt are available. But it appears to me that any such discussion had better be deferred till someone finds a fossil pterodactyl with a fossil flying-fish in its mouth. At present the idea seems only to be of value in suggesting or stimulating lines of research. A question that demands an answer is whether the conditions of the air a yard or two above the surface of a tropical sea, and also whether the structure of the pterodactyl, were such as to permit the continuous and high speed soaring flight that would be necessary for flying-fishes to be caught in the manner suggested ? Let us in the first place see whether there is any detail in the anatomy of pterodactyls suggesting that they were not adapted for soaring at a height above the earth, and therefore consonant with the idea that they usually soared at low levels ?

The shoulder joint of birds is a ball and socket. Consequently birds can rotate the whole wing at this joint. As has been mentioned above, the shoulder joint of the pterodactyl was a simple hinge. These reptiles must therefore have lacked the power of wing rotation. Let us consider what effect this disability may have had on their flight.

Anyone who has been up in an aeroplane will remember the sensation of " bumps " which are caused by the machine entering ascending currents. It can be deduced from my observations that vultures soaring at a height above the earth are not troubled by bumps for the following reason.* In the diagram Fig. 12, a wing is represented fixed on to and at some distance above a truck which is running on a horizontal railway line. Supposing, as at A (in the absence of wind), the truck is moving in the direction of the arrow *e*, then anyone standing on the front edge of the wing would feel a current of air rushing past him in the direction of the arrow *f*. This air current is the " relative wind " due to the movement of the truck through the air. Now suppose, as at B, the truck is not moving ahead, but that an ascending current of air *g* exists under the wing. In this case the observer's relative wind will be in the direction *h*. Now

*For the sake of clearness all reference to the angle of incidence is omitted in this description.

imagine that, as at C, the ascending current g still exists, but that the truck is moving ahead; then there will be a relative wind k, because the movement ahead tends to make a relative wind as at f, while at the same time the ascending current tends to make an ascending current as at h. These two influences must combine making a resultant relative wind k. This relative wind is in such a direction that it must exert a considerable

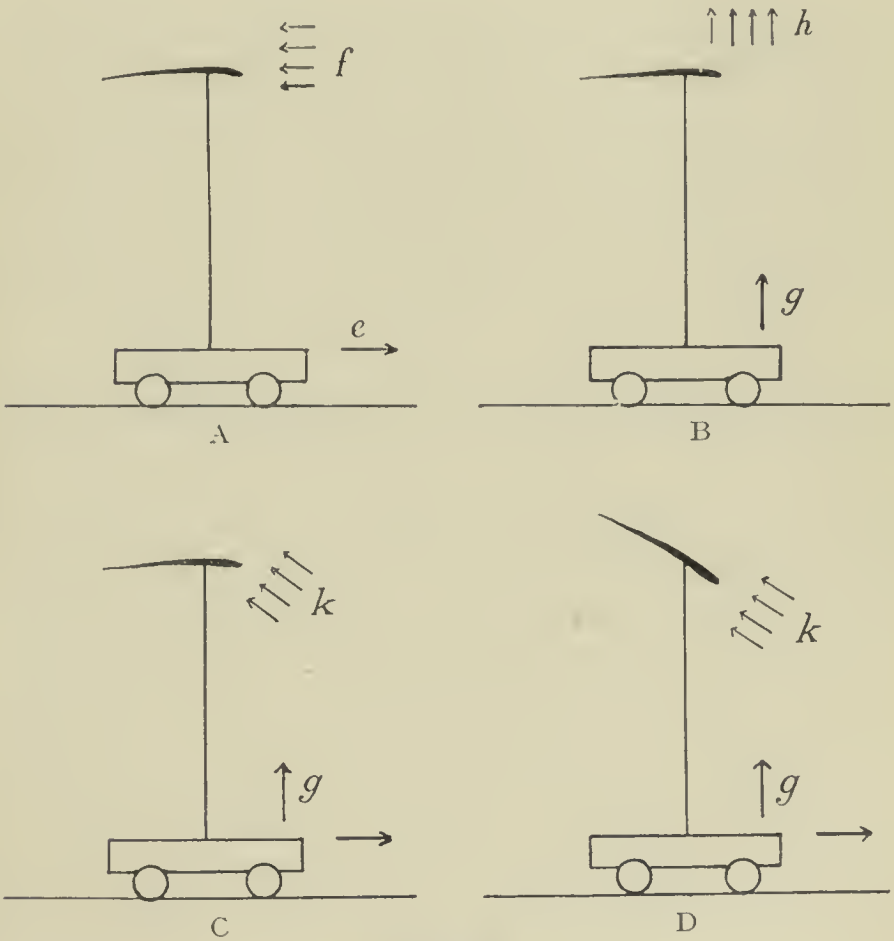


Fig. 12

pressure on the underside of the wing. At the moment of entering the ascending current, therefore, the observer on the wing would experience a bump. But he would not feel a bump if, at the moment of entering the ascending current, the wing was rotated as shown at D. This is what a vulture does when entering such a current when at some height above the earth. With the aeroplane wing there is no such rotation.

Hence the sensation of bumps.* The pterodactyl suffered from the same disability. Therefore it seems probable that, differing from vultures, it was ill-adapted for flight at a height above the earth where strong ascending currents frequently exist. Such disability would not be of importance if, as previously suggested, its soaring flight was confined to a short distance above the surface of the sea where strong ascending currents are not likely to occur. The wing rotation above described results in the vultures getting increased speed ahead from the ascending current instead of lift. With smaller soaring birds at low levels in ascending currents such wing rotation usually occurs only to a lesser degree. In such cases they get lift rather than increased speed from the current. On leaving the current the relative wind momentarily presses on the upper surface of the wings, producing an appearance of instability greatly misunderstood by me and described as " tail-jolting " (*Animal Flight*, pp. 85 and 143).

We possess detailed knowledge of the wing adjustments of which pterodactyls were capable, thanks to a singular accident. Owing to their fragility, the fossilised bones of the larger pterodactyls are usually found completely crushed. But some years ago, some perfect uncrushed specimens of parts of the bones of the wing of a large pterodactyl came into the possession of the British Museum (Natural History), and were subjected to a searching examination by Professor D. M. S. Watson. He discovered all the movements of which each of the joints of the wing were capable. They were found to be remarkably complicated. The different parts of the wrist joint, for instance, were capable of no less than five different movements of which some were inseparably connected. The structure of the elbow joint is particularly surprising. Professor Watson discovered that, of the two bones of the fore-arm, the ulna articu-

*My observation of an apparent large negative angle of incidence shown sometimes by vultures when in horizontal gliding flight (*Animal Flight*, p. 198) is simply explained by supposing that they were at the time in an ascending current, and that their wings had a normal small angle of incidence with the relative wind. Lack of familiarity with the conception of relative wind led me to regard my observation as remarkable, and led others to regard it with scepticism. Owing to this lack of familiarity it appeared to me advisable to submit the above description of the nature of bumps to Mr. Handley Page, and he kindly allows me to say that it is correct.

lates with the humerus with a rounded surface which, as in other animals, is part of a circle. But the other fore-arm bone, the radius, has an articular surface which is not part of a circle but part of some kind of spiral. The result is this : that when the elbow was extended, the radius travelled outwards for a short distance in the direction of its length, while keeping parallel with the ulna. The extent of this travel was only about a quarter of an inch for a pterodactyl of over sixteen feet span. That this travel actually occurred is proved by the fact that the radius and ulna were in contact with each other near each end, and the points of contact were developed into articular surfaces. The travel, though small in extent, had an important effect on wing adjustment in that it caused a rotation of the wrist joint, as was proved by Professor Watson's minute examination of the shapes and articular surfaces of the carpal bones. Thus downward movement of the wing at the elbow joint was inseparably connected with rotation of the outer part of the wing at the wrist joint.*

It appears to me to be impossible at present to make any guess worth recording as to the effect on flight either of these related movements or of the other movements of which the different parts of the wing were capable. Thus further knowledge of the nature of soaring flight seems to be needed before we shall be able to answer the question whether it was possible for pterodactyls to catch flying-fishes.

*These discoveries are described in detail in a paper entitled "On the Flight of Pterodactyls," in the *Aeronautical Journal*, Vol. XVIII., October, 1914, p. 324. Though written by me jointly with Professor Watson, the credit for the above discoveries is due entirely to him.

II

BIRD MIGRATION AT SCOLT HEAD

In the autumn of 1924 and 1925

By E. L. Turner, F.L.S., Hon. M.B.O.U.

Scolt Head as an observation post possesses several advantages. It is the highest sandhill on the Norfolk coast and consequently commands an extensive view in all directions. Being on an island the observer can concentrate on a relatively narrow front instead of wasting energy in exploring over a wide countryside. The north Norfolk coast receives not only the stream of migrants returning from the north, but also that which comes in from the east. Therefore the opportunities afforded by Scolt Head for the study of migration are of extreme importance, and open a far wider field for research to the ornithologist than the mere guarding of the breeding birds. We are so ignorant really about the great mystery of migration, but every little bit of careful work may send a ray of light into the darkness. Why for instance should the tiny Goldcrest undertake the perilous journey across the North Sea or the Mediterranean Sea, when suitable winter quarters could be found near, and often within its breeding area? It weighs about as much as a sheet of writing paper and an envelope, and measures only $2\frac{1}{2}$ inches across the wings. At home it merely flits from tree to tree, and appears quite incapable of sustained flight. How does it accomplish the apparently impossible?

When the autumn diurnal migration is in full swing the birds stream past the Head from dawn till dusk, and in all weathers. Sometimes the best observations are obtained in the worst weather. Throughout the autumn the bulk of the birds pass over as a rule in the early morning between dawn and 10 a.m.

The observation grounds from Brancaster Creek to the east side of House Hills, together with the intervening marshes, must be gone over daily at regular intervals, and periodically the whole round across Norton Creek to Deepdale Mere, along the wall to Overy, across Overy Harbour and back by the shore.

Even in such a restricted area there are certain definite

places where incoming birds are most likely to be found. Certain marrams and bushes near the sea, and the shingle spits below the hut towards the far beach, proved to be the usual resting and feeding places of the smaller passerine birds, which are mostly nocturnal migrants. From August 31st to September 4th, 1924, these shingle spits were covered with Wheatears, Redstarts and Whinchats, while the bushes were full of Pied Flycatchers and warblers of many kinds, the wind during the five days being easterly. During the first fortnight of September in the following year, 1925, the prevailing winds were westerly, and then few birds were driven in for food or rest, the only records being one Willow-Warbler, one Garden-Warbler, a few Hedge-Sparrows and Reed-Buntings. Two or three Wheatears came in daily, the greatest number on any given day being thirteen on September 1st. Of other Chats—five Redstarts, one Stonechat, three Whinchats, and one immature Bluethroat, were the only birds recorded. Both in 1924 and 1925 a few Wrens were flushed from the marrams. As these birds always seem to be exhausted and utter no sound, they are easily overlooked. During both seasons they appeared about the same date (September 15th), and one or two apparently took up their winter quarters on the island. Between March and September no Wrens were in evidence.

Another very favourite haunt of warblers and chats is the east side of House Hills. Here there were a few elder bushes, and when the sun rose, almost every bird sitting there could be easily watched and identified; but in November 1925 these bushes for some unknown reason appeared to be dying.

The *Suæda* bushes between the big thorn bush at the Overy end and Overy Creek, yielded better results than any other area in the whole island, while the saltings between House Hills and the thorn bush only once during the two seasons produced a bird worth recording—a Golden Plover in full plumage. From information received it seems probable that the rarer waders come up the Overy channel to the fresh water swamps and marshes at its head.

A narrow bight which runs up between the main sand hills and the ternery is one of the favourite feeding grounds of Shore-Larks and Snow-Buntings. In 1925 Snow-Buntings were late in arriving; the first flock alighted on this bight on

October 31st. The Shore Larks already in possession since October 7th resented their intrusion, and several of them rushed at the Snow-Buntings with angry gestures, puffing out the so-called " horns " over the eyes and raising the feathers of the crown. Shore Larks are very attractive birds, easily overlooked when they are feeding amongst maritime vegetation. As a rule these birds were fairly tame, but when startled they flew up in a bunch uttering a distinctly wader-like cry akin to that of the Common Sandpiper. This note was also uttered on the wing as they passed over with Skylarks, the two species occasionally travelling together. On October 31st a solitary Firecrest flew in from the sea, near the ternery. It flattened itself for a moment against a hurdle, then dropped into the marrams. This " scrap of valour " was apparently not in the least exhausted for pursuit was in vain. Each time the bird was flushed it flew some distance before dropping down to rest.

Even in a comparatively small area like Scolt Head with its five miles of foreshore, certain stretches of water and certain saltings were always favoured by particular species of birds. The shore near the ternery and off Smugglers Gap were the favourite haunts of Sanderlings. The saltings in widely separated situations were frequented by Turnstones and Grey Plovers. In 1924 and 1925 both these species were first noted in exactly the same spot. The sea opposite Smugglers Gap was a favourite haunt of Grebes and Divers. In April 1924 a bunch of seven Velvet Scoters were always to be found in a limited area below the Head, while the mass of Common Scoters blackened the sea considerably further out and more to the west. These are only a few examples of a particular liking for a particular area. All these species might be, and frequently were, found anywhere along the shore. But given a bad day and limited time, certain spots always produced certain birds provided there was any movement. The saltings below the hut were the resort of many species on arrival. Two Kentish Plover alighted there with the first batch of Shore-Larks. Curlew Sandpipers too haunted the edge of the marsh for days, feeding amidst the *Obione*.

Birds crossing the water on the wing at a low level are always difficult to see. An inky smudge moving rapidly over the face

of a sullen sea appearing a few miles out gradually becomes definitely visible. This may resolve itself into a flock of large passerine birds passing overhead with steady purposeful flight, or a bunch of waders coming in at top speed and gone in a moment, so that the watcher is grateful for any startled cry which may help to identify them.

Few people realize that the autumn migration really begins in early June, i.e., directly the first broods are able to fend for themselves. Many young birds prefer the society of their contemporaries and wander far afield in search of new feeding grounds ; this is especially the case with double-brooded birds like Starlings. But often old and young move away from their nesting area together as in the case of waders. In addition there are numbers of immature and non-breeding birds which throughout the year move from one feeding ground to another.

Consequently there is sometimes an overlap in the spring and autumn migrations. Swifts for instance were travelling west from May 4th (1925) till June 21st. From May 28th to June 3rd they passed the Point, beating against a head wind in vast numbers. Probably these late Swifts were rushing towards their breeding places in the most northerly limit of their range. On the other hand during the first week of June the first flocks of young Lapwings (birds of the year) began to come in from the east, and Redshank about the third week. In fact there is no week in the year when birds are absolutely sedentary ; always there is movement of species to and from their breeding areas. The bulk of waders are on the move during the third and fourth weeks of August ; Redshank, Dunlin, Ringed Plover, Spotted Redshank, Curlew and Greenshank, having been noted as passing over Cambridge during the last week of August, calling sometimes all the night through from about 9 p.m. onwards.

On the north Norfolk coast this passage movement, both in spring and autumn, is largely from east to west ; in the autumn at least part of this stream of migration must ultimately turn south, probably up the Ouse and Nene valleys to the Thames, and so across to the coast of France.

Birds travelling from east to west past Scolt Head first come into view over Holkham woods. The various flocks follow definite flight lines, and these, radiating from Holkham,

spread out fanwise towards the west. One line stretches from Holkham Bay towards Skegness, the second crosses the sea in the middle distance, the third follows the edge of the tide, a fourth takes the line of the sand-hills, a fifth follows the creek, and a sixth keeps to the mainland uplands. Most of these lines converge near the Wash, and it would be of interest to know the direction then taken, as numbers must ultimately turn south.

The first two flight lines are difficult to follow as they are far-flung, but sometimes birds of one species move simultaneously along all the lines at once. For the most part however, they come along in streams or small parties and take one or other of these flight lines. There is also a cross migration from north to south, and this is often on a very wide front.

In 1925 the first flocks of Starlings came in with an easterly wind on June 10th, 11th, and 13th. On the first two days they flew at a high altitude steadily west. From the 13th till the end of the month there were large mobile flocks feeding on the marshes. Observations were not made during July and August, but throughout September small parties frequented the saltings and bushes on House Hills, no big rush taking place until September 29th, when the wind blew from the S.S.W.

A good many Teal arrived early in September. From the middle of the month waders and birds of all kinds came with a rush. Dunlin, Ringed Plover, Golden Plover, Redshank, Curlew and Oyster-catchers might on some days be counted by hundreds. Greenshank too were numerous; there were a few Knot and Godwit, one or two Purple Sandpipers, Mallard and Wigeon were plentiful, and Sanderlings abounded everywhere.

September 13th and 14th were wonderful days, so warm and sunny that the birds returned to spring-like habits, Curlew bubbled, and Redshank yodelled. It seems as if waders have an autumn song period as do Robins and some other warblers and finches. Larks filled the sky with melody, Linnets trilled and Swallows twittered as they swung past the Head. At dawn on the 14th a solitary Redstart flew into the hut, and then the real movement had begun.

About 4.30 p.m. the air was suddenly filled with a rush of wings. From end to end the island was alive with Swallows

and Black-headed Gulls, both species playing round the sand-hills, black and white curiously blended. The Swallows twittered merrily, the Gulls chattered, and they seemed to be merely amusing themselves, for no insect life was visible in the air at the time. By 6 p.m. most of the Swallows had disappeared, but the Gulls remained playing round the hills as the sky changed from blue to mauve and then to grey, and twilight fell. Suddenly the Gulls began to soar very slowly until all from the island had mounted high into the air, circling round each other in ever-widening rings until they became invisible to the naked eye; then gradually they spread out and flew steadily westward away into the daffodil sky high above the setting sun, until they were finally lost to view. It took them thirty-five minutes to mount spirally upwards before turning west. A few Swallows and one single House-Martin still played round the Head and later on several Swifts, two Tree Pipits and some Yellow Wagtails passed, while small parties of Curlew uttering their travelling cry, and a number of Lapwings flew across the hill.

Throughout September vast numbers of Skylarks passed west regardless of wind or weather, often travelling singly, but sometimes in little bunches of from three to seven. Finches, including Linnets, Buntings, and Tree-Sparrows, flew by in hordes and resembled a cheerful Bank Holiday crowd, for under favourable conditions they twittered continuously.

Grey Geese arrived on September 25th, and from that time onwards hundreds of them were seen and heard daily. Great Crested Grebes, Gannets, and Cormorants were constantly passing along the sea. Skuas, including one Pomatorhine Skua, appeared in numbers on September 27th with a north wind. The only others recorded were two Arctic Skuas on October 14th, again with a northerly wind. Yet in 1924, Skuas were recorded almost daily from August 26th till the end of September. We frequently came across tired birds all over the saltings, the prevailing wind being S.S.W. On October 2nd (1925) we saw what were undoubtedly seven Surf Scoters, the white patch on the neck being plainly visible. This is the first record of Surf Scoters for East Anglia. Short-eared Owls were frequently flushed from the marrams. Little Owls came in from the sea, especially near the ternery. Small

parties passed over the hut at dusk calling to each other as they flew, but whether they came merely from the Lincolnshire coast, or whether they were actually overseas migrants, it is impossible to say.

Throughout September and up to October 6th Swallows, Sand-Martins, and House-Martins, passed continually from east to west against a westerly wind. None were recorded flying south. September 18th and 19th were remarkable for the numbers of immature and adult Swallows migrating together, whereas the flocks of Swallows passing on September 25th, 27th, and 28th, contained few immature birds. Very few Swifts were noted throughout September, five on September 30th were the last to be recorded in 1925. At 11 a.m. the same day, a great company of Black-headed Gulls again invaded the island in a S.S.W. wind. All day long they hawked for red ants on the wing. At 5 p.m. the wind suddenly veered round to the east, and an hour later the tide had risen and covered the mud flats ; then at last the whirling of countless wings ceased and the Gulls rested, some in the bights and some on the sea, where to the west the water gleamed red-gold under the setting sun. Right out to the harbour-bar the Gulls were floating on the golden water ; gradually the far beach became covered with them, standing in serried rows on the horizon, thousands of them now merely showing as black shadows in the dusk. There were very few immature birds in this second visitation. The next day not a single Black-headed Gull was visible.

The number of Lapwings moving from east to west when there were big rushes seemed almost incredible. Day after day these immense movements continued without a break, but the largest flocks passed in the early morning. The direction of the wind made little difference to these big rushes, except that the birds flew higher in the air with an easterly wind. The slow flickering flight of the Lapwing can be identified for long distances. Sometimes they came in from the sea and would then continue in a southerly direction, particularly in a south east wind.

A strong S.E. wind amounting to a gale raged all the night of October 19th, and at dawn on the 20th rain still fell in pitiless fury. There was no movement at all from east to

west, but many species were coming in from the sea, among them two small flocks of Lapwings, from which an exhausted bird dropped to the shore for a moment, and then wearily rose and followed the others south. Two flocks flying low down over the sea suddenly rose high in the air when they reached the shore, then circling spirally upwards they divided, and some flew due south while others followed the tide line to the west. Flocks of finches behaved in exactly the same extraordinary manner.

From October 30th there was a cross migration of Skylarks from north-east to south-west, and those coming straight in off the sea crossed the island and made for the uplands. On some days with a following wind they flew high up, at about 200 feet, but when beating against a head wind they flew so low that at times they almost brushed the sand-hills, or only just cleared the waves when following the tide line and buffeted by the wind from the sea. On such occasions numbers probably perish, as an extra big wave must surely overwhelm them.

From this date a cross migration of finches, linnets, buntings, and Tree Sparrows began from north to south, while throughout the whole month, no matter from what quarter the wind was blowing, immense flocks of Starlings passed daily, some coming in from the sea and flying south, but the greatest movement being from east to west. Like all other species in an east or following wind, these finches flew from 100 to 200 feet above the island; whereas in a westerly or head wind, they would only just top the hills and always dropped to the lowest possible level over the marshes and sea. Sometimes packs of birds followed one another so closely that there was scarcely one minute's interval between them. Frequently a dense column extended for more than a mile in length. They never loitered, but sped towards their goal at top speed and the noise of their wings was like the sighing of wind in the tree tops. They looked like countless miniature torpedoes hurled through space, and made the hordes of crows seem hopelessly slow.

It is of course impossible for the ordinary observer really to measure the rate of flight. According to careful computations made by Mr. Meinertzhagen, the average pace of the smaller passerine birds is 20 to 27 miles an hour, that of Crows 31 to 45,

while Starlings reach 38 to 49. The Starlings seemed in reality to fly much faster, and at times it must have been so, because certain flocks sighted as soon as they touched the Overy end of the island and kept in sight until they reached Brancaster Creek, outpaced and passed several flocks of Hooded Crows taking the same flight line.

We only recorded five Carrion Crows, but Rooks came in with Hooded Crows on October 9th, large flocks passing throughout the month, sometimes from east to west, but frequently great numbers came in from over the sea flying from N.E. to S.W.

The most impressive sight however was the passing of the Hooded Crows. Countless hordes moved from east to west along the five flight lines, and numbers came in from the sea. Sometimes they flew so low that their wings made flickering shadows on the windows, and almost brushed the heads of anyone standing on the sand-hills. Slowly, silently and relentlessly they went on their way. Numbers alighted on the island and along the uplands. The first flocks however moved on after feeding and resting. Later on, numbers remained and apparently took up their winter quarters on the marshes. Apparently the numbers of Hooded Crows passing during the autumn of 1925 were unprecedented within the memory of the "oldest inhabitant" of Brancaster, and they were looked upon as forerunners of a hard winter. This common myth must be absolutely without foundation, as it is much more reasonable to suppose that these hordes were the result of an unusually prolific breeding season.

As October advanced hundreds of gulls of various kinds, Common, Herring, and Great Black-backed, came from the uplands to feed in the creeks at low tide. The shore at certain points became a great *rendezvous* for gulls. There they dozed away their leisure hours sleeping with one eye open, for as soon as anyone appeared within half a mile of them they moved on. The regular order in which a battalion of gulls standing at ease moves slowly ahead of the intruder is interesting and amusing. As he walks towards them, the birds nearest to him will flutter along the ground with uplifted wings and rise just high enough to float over the pack, and then alight ahead of it. Then another batch from the back will follow suit, and thus in

a few minutes the whole battalion has forged ahead without undue haste or loss of dignity. The intruder can never catch up with them, for if they are shy and he approaches too near, they will all rise and fly away together.

Few thrushes of any kind alight on the island as there is very little food to attract insect-eating birds, and still less fresh water. Nevertheless thrushes passed over continuously. One of the last nights spent on the island has left a lasting impression upon the memory because of the numbers of Redwings passing overhead. It was a perfectly still moonlight night, so quiet that even the plash of the waves was inaudible from the Head. No sound broke the silence but the faint travelling cry of the Redwings. The birds themselves were invisible ; they came out of the void from somewhere overseas, and their cries trailed away into the purple night as the birds flew towards their ultimate goal.

The charm of the late autumn migrants lies in the fact that it can be seen and heard. As nothing definite can be proved about the east coast routes in the short period of two years, it is to be hoped that trained observers will take advantage of the splendid opportunities afforded by Scolt Head and carry on the work.

III

THE ECLIPSE PLUMAGE IN ITS BEARING ON THE LIFE-HISTORY OF THE DUCKS

By Lord William Percy, C.B.E., D.S.O.

There are certain aspects of the problem presented by what is known as the "eclipse" plumage which, when viewed in relation to the family of ducks as a whole, would perhaps repay more investigation than has hitherto been accorded to them.

If the average ornithologist was asked to state the chief characteristics that distinguish the life history of the ducks from that of other birds, he would I suppose reply that, while they are a monogamous family of birds, the males exhibit the

extraordinary peculiarity (amongst monogamous birds) of leaving their females at some period during incubation, and thereafter absenting themselves altogether from the society of their females and young at the very time when other monogamous birds are most constantly in attendance on them. And moreover, that during this period of divorcement from their females the males go through a strange metamorphosis, which is commonly known as the eclipse plumage.

Now, if it is correct to say that the above represents the view of the average ornithologist, however much of truth it may contain as applied to the ducks of the palæartic regions, it is entirely untrue as applied to the family as a whole. Indeed I believe it would be correct to say that it represents the habit of less than half of the ducks of the world, which can be placed somewhere in the region of 200 species.

But for the moment let us see how much truth there is in it, for, as applied to the ducks with which we are familiar in the palæarctic regions, it is largely, but not universally, correct. It is true that the males of almost all our northern ducks do go through this period of divorcement from their females and this so-called eclipse, and it has always seemed to me extraordinary that more study has not been devoted to the phenomenon. As a matter of fact, I know of no one who has devoted himself to it except Mr. Millais, and those who are familiar with his "British Surface-Feeding Ducks" and "British Diving Ducks" will remember that, while he alludes to the causes of the phenomenon as extremely obscure, he advances two possible explanations to account for it. The first is that, as the period of the "eclipse" involves a period of complete flightlessness (the primaries being all moulted at the same time), the dull eclipse plumage serves as nature's protection during that period of flightlessness. The second is an allusion to the "couvade," a custom that obtains in widely separated parts of the earth amongst the human race, by which a husband whose wife is about to bear a child retires to bed and suffers from sympathetic pangs which the local medicine men assert are not imaginary. I do not feel competent to comment on the second suggestion, but the first, i.e., protective colouration during the period of helplessness in the flightless condition, is, I think, demonstrably wrong, as I shall attempt to show.

I would make three contentions with regard to it :—

(*a*) That colour protection is not needed.

(*b*) That if it were needed the eclipse plumage would not provide it, and indeed frequently makes the bird more conspicuous.

(*c*) That whereas all species of ducks the world over become equally flightless during the moult, a very large proportion of species have no " eclipse " and do not desert their females or young.

Taking these contentions in order :—(*a*) If there is one period of the year when the male is less in need of protective colouration than at another, it is during the period of eclipse. He who attempts to collect examples in that condition soon becomes painfully aware of this, for those species that frequent cover disappear completely, while those that live on open water become so incredibly wild as to be almost unapproachable, and absolutely unobtainable without infinite labour and trouble. For instance a man can shoot as many Common Eider drakes in full plumage in a day as he wishes in numberless places in these islands, but the man who collects a complete series of Eider in 1st, 2nd, and 3rd year eclipses will have to work, and work hard, for years to do it, even though he may be able to see hundreds every day for several weeks.

It is not generally realised how exceedingly rare specimens of some of our common ducks in the eclipse stage are in collections. In spite of the prodigious accumulation of skins in Europe and North America in the last 100 years, specimens of some even comparatively common ducks in eclipse are either non-existent in any collection in the world, or can at most be numbered on the fingers of one hand. The Goosander for example is a common bird in these islands, but until a few years ago there was no specimen of that bird in eclipse in any collection in England, and there is not one to-day in our national collection. The rarity of specimens of all ducks in eclipse is an excellent index to the difficulty of obtaining them.

(*b*) If protective colouration were needed, the eclipse plumage would do less than nothing to provide it. Consider for example the eclipse plumage of any of the eiders. The bird in full plumage invariably possesses a parti-coloured dress of white, black, and green, amongst other colours ; such an

object at sea is not at all easy to pick up amongst wave crests or ice, but as soon as the black eclipse plumage is assumed the bird immediately becomes a most conspicuous dark object in light surroundings. Comparatively tame in full dress, the male assumes with the first traces of the eclipse a well-nigh incredible shyness which makes it difficult to put a boat on the same square half-mile of sea. If he were an inhabitant of cover like the surface-feeding ducks he would have hid himself in a dense reed bed from which no dog could eject him. All males of the ducks which undergo eclipse seek protection in one of these two ways : concealment in cover, or wildness in the open, but never in protective colouration.

(*c*) Ducks outside the palæarctic regions become just as flightless as our northern ducks, but many species do not undergo "eclipse."

If then protective colouration is a false reason for the "eclipse" transformation, we must look elsewhere for it, but I must now define the sense in which I am speaking of this "eclipse" plumage. By "eclipse" I do *not* mean the fact that the bird undergoes a moult. All drakes of all species of ducks of course do that. By "eclipse" I mean that in certain species *the moult involves the literal eclipse of the distinctive colour pattern of the drake.* That is the important thing to bear in mind for the purpose of the point I am now trying to make.

As regards the vast majority of the palæarctic species of ducks, the male possesses an entirely *different colour pattern* from the female, and wherever that is the case the male invariably leaves the female at some period during incubation and never returns to her that season, but goes away by himself, or with other drakes, and undergoes an eclipse of his distinctive colour pattern. This then is the first rule—"where the colour pattern of the sexes is different the male will leave his female and undergo eclipse." But, what is much more interesting, a second rule which is the converse of the first will be also found to apply—"where the colour pattern of the sexes is the same the male will neither leave the female, nor undergo any change of colour pattern." Here let me say at once that while I know of no exception to the first rule, there are several to the second, but the applications of the rule are so much more

significant than the exceptions that it seems best to state the rule and deal later with the exceptions.

The first rule in its application to our northern ducks is familiar to every naturalist acquainted with the life history of our ducks ; but in England we have but one duck to which we can apply the second rule—the Common Sheld-Duck—for it is the only English breeding duck in which the sexes have similar colour patterns.

The drake will be found to comply with the rule. He neither leaves his female during the breeding season nor does he undergo eclipse of his colour pattern.

Now I was familiar with this solitary exception amongst English ducks many years ago, but was misled into the belief that his exceptional habit of staying with his female throughout the breeding season was merely indicative of his close relationship to the geese, which of course do not share the eclipse habit of the ducks. It was not till I went to southern countries to study ducks that I became aware of the fact that our Common Sheld-Duck is in reality only complying with a world-wide rule, although the species happens to be the solitary exponent of it in this country. This solitary English exception becomes in southern countries the rule, that is to say, while in England the sexes in the vast majority of our ducks exhibit different colour patterns, in southern latitudes by far the greater number have the same patterns. Accordingly the second rule applies, the males do not desert their females and young, and they undergo no change of colour pattern during the moult.

Just as our Sheld-Duck is an exception with us in respect of a similarity of colour pattern, so in South America there are a few species which are exceptional in having different colour patterns, and the interesting proof of the validity of the rule is that in both hemispheres the exceptions obey the rule that is applicable to them.

With the mass of South American ducks it is rare to see a brood without both parents. In England (with the exception of the Sheld-Duck) such a sight may be said to be unknown. The males of the South American ducks are just as active participants in the rearing and defence of their broods as the females, if not more so.

As an instance of this, and to show how utterly different is the psychology of the drakes from that to which we are accustomed here, I will record an experience I had two years ago in a group of islands off the southern coast of Chili. I was upon a small densely-wooded island watching the broods of Kelp Geese on the rocks that fringed its edge, when I saw a pair of Steamer Ducks bringing their brood of six inshore to feed. I lay down behind a rock and the party swam up to within fifteen yards of where I lay, and the young birds began to dive amongst the kelp. The parents took no part in procuring food for them, but just floated about preening themselves.

After watching them for about half an hour I decided that I wanted one of the young in down, and waiting till one was separated from the rest I shot it. It got one pellet in the head and rolled over on its back with paddles up. The rest of the brood rushed to the female who remained quite motionless on the water. The male eyed the splash made by the shot on the water for a few seconds, and then, calling loudly, rushed at the dead bird with beak wide open and lashing the water into foam with wings and feet. He " steamed " right up to the dead bird in this way and looked as if he was about to deal it a heavy blow with his bill, but when within a foot of it he dived underneath it, to reappear immediately on the other side, steamed on towards me for fifteen yards, turned about, and repeated the same performance over and over again. His piercing calls and the terrific commotion this 12-17 lb. bird made in the water, together with the astonishing rapidity of his attacks, made one of the most impressive spectacles I have ever seen in bird life. After what seemed a very long time I was tempted to end his pathetic frenzy with a shot, but he suddenly stopped and joined the female (who had remained motionless with her brood huddled to her side all the time), and they all swam slowly off to sea.

It was not till then that I realised, or thought that I realised, the meaning of his action ; but I am convinced that never having heard a gun before, the thing that he associated with the death of his offspring was the splash made by the shot on the water, and that his subsequent actions were an attack on what he supposed to be a submarine enemy that had killed

the young bird. I had of course remained hidden all the time and none of the party had even suspected my presence.

Now the interest of that experience was this ; an English Eider has very similar habits to those of a Steamer Duck, but at a similar season our English Eider would long ago have lost all interest in his female and her brood which he had never seen, and would be in full black eclipse plumage obsessed with only one idea, to put himself at sea or on a rock in such a situation that he could see the approach of anything at least half-a-mile away. That Steamer Duck (typical case of similarity of colouration) and our English Eider (typical case of dissimilarity of colouration), are admirable examples of the extraordinary bearing which this similarity or dissimilarity of colour pattern in the sexes has on the life history of the ducks.

Now if it is correct to say that dissimilarity or similarity of colour pattern as between the sexes is the deciding factor in the assumption of an eclipse plumage (and consequent desertion of the female, etc.), the explanation of this strange chapter in the life-history of the ducks should surely be sought for in this direction, and not in such things as protective colouration.

Perhaps the explanation lies far back in the evolutionary history of this family. I do not pretend to be able to read the riddle, but it would be interesting to know the answers to such questions as " which is the older type ; that in which there is similarity of colour pattern, and domestic felicity reigns ; or that in which there is dissimilarity of pattern and yearly divorcement takes place ?" " Is the eclipse some sort of reversion to an ancient Type ? " At all events as far as my field experience goes (and it extends to more than half the species of ducks in the world), I find that this statement holds good :—" *Whenever the colour pattern of the sexes is markedly distinct the male invariably leaves the female during incubation and undergoes eclipse. Where the colour pattern is similar the male almost invariably stays with the female and undergoes no change of colour pattern during his moult.*"

I have made no qualification to the first part of the rule because if exceptions exist I have not found them ; but I have purposely qualified the second part of the rule, for, though the exceptions appear to be insignificant when compared with the applications, they are somewhat remarkable.

The outstanding exceptions are the various species scattered widely over the world which are generally regarded as very closely allied to the Common Mallard (*A. boscas*), (a typical example of dissimilarity of colour pattern, eclipse, and consequent desertion of the female).

The Black duck (*A. obscura*) and the Florida duck (*A. fulvigula*) of North America, the Spotbilled duck (*A. pœcilorhyncha*) and *A. Zonorhyncha* of India and Eastern Asia are typical of the group of species referred to. In each and all the colour pattern of the sexes is identical, and the males should therefore (according to the rule) remain with their females throughout the breeding season. As far as I can ascertain none of them in fact do so. They all follow the example of their near relation the Common Mallard, which is the least monogamous, and the most typical example of different-colour-pattern-psychology amongst all our ducks, and perhaps the very closeness of their relationship accounts for the fact.

IV

METEOROLOGICAL NOTES, 1925

(*From observations taken at Norwich*)

By Arthur W. Preston, F.R.Met.Soc.

JANUARY

This was a mild month, the mean temperature having been 3.4. deg. above the average. It was also a dry month, not much more than half the normal fall of rain having been registered, and, as in all the preceding autumn and winter months, there was no snow. There were, however, alternate gales and fogs, but sunshine was somewhat more frequent than usual. By the close of the month the mild weather had brought crocuses and other spring flowers into bloom.

FEBRUARY

South-westerly winds and mild weather prevailed during this month, with rainfall slightly in excess of the average, but no snow fell until the 21st, which was the first snow of the winter, although the amount was but trifling. Many years have elapsed since so late a first snowfall occurred. On the evening of the 26th the mercury fell to 28.71 ins. There were gales on several days and nights, the most severe having been on the evening of the 9th, when there were terrific gusts, doing much damage. During this gale the barometer rose .27 in. in an hour and a half.

MARCH

This month was a particularly trying one, having been winterly nearly throughout, which, following the continuously mild weather since October, made the cold acutely felt. There was a complete absence of mild spring days, the highest temperature recorded having been only 53.9 deg. (on the 16th) which was the lowest March maximum since 1883. Snow fell on 8 days and there were 13 nights with frost in the screen and 25 nights on the ground. Sunshine was over 28 hours deficient and was not more than half the amount registered in the previous March. Thunder occurred on the 1st and 11th. Vegetation which had had an early start was much retarded.

APRIL

A sharp frost occurred on the 4th, when the thermometer fell to 26.1 deg. in the screen and to 20.2 deg. on the grass. This was the sharpest April frost recorded here since 1917. Some warm weather occurred at Easter, but very unsettled weather followed, and a gale on the morning of the 16th was strong enough to break away R 33 from her moorings at Pulham. A constant series of shallow depressions caused the weather of the latter part of the month to be in a chilly and unsettled condition, with frequent cold showers of hail and rain. The month's rainfall was .79 in. in excess of the normal, and sunshine was 47 hours deficient.

MAY

The maximum temperature of May Day (48 deg.) was 3 deg. lower than that of New Year's Day and 7 deg. lower than that of January 2nd. Warmer weather followed, and by the 16th the thermometer rose to 80 deg. The mean temperature of the month was 3.4 deg. above the average and the total sunshine exceeded the combined sunshine of March and April. A remarkable feature was an unusual prevalence of early morning thunderstorms. On the mornings of the 7th, 16th, 18th, 19th, 20th, and 24th, sharp storms occurred between 4 and 6 a.m. At the close of the month the whole countryside was clothed with the richest verdure, and the flowering shrubs were very beautiful, although some, such as lilacs and laburnums, failed to give such an unwonted display as in the previous year.

JUNE

Magnificent weather prevailed during the greater part of the first three weeks of the month, with many brilliant days and some great heat. The thermometer exceeded 70 deg. on 11 days and 80 deg. on 4 days, reaching 83.2 deg. on the 11th. During the first 20 days only 0.01 in. of rain fell. During the week ending June 28th a change to almost winterly weather occurred, the temperature not once rising to 60 deg. during the week; 0.60 in. of rain fell during this week, which was acceptable, and was considerably in excess of that of many places further south, some of which were absolutely rainless. Warm weather returned at the close of the month. It was the driest June since 1921, the month's total rainfall having been 1.32 in. deficient.

JULY

This was an exceedingly fine, warm month down to the 25th day, the temperature exceeding 70 degrees on 19 days and 80 degrees on five days, the maximum (22nd) having been 87.2. The mean temperature of the month was 2.4 degrees above the normal, and with the exception of 1921 and 1923 was the highest of any July since 1911. But little rain fell until the 20th when a sharp thunderstorm brought 0.34 in. of

rain, and further rains occurred on the 22nd, 26th, and 27th, bringing up the month's total to 1.68 in., nearly an inch below the average.

AUGUST

This month was wetter than the two preceding months, and although there were some fine, bright days in the middle of the month, no great heat was attained, the highest reading of the thermometer not having exceeded 77 degrees. Sunshine was 23 hours deficient. Very heavy rain occurred on the 24th, and showery weather about that date interfered much with the harvest. North-westerly winds predominated. There was not much thunder here.

SEPTEMBER

Cold and unsettled weather prevailed nearly throughout the month, the mean temperature having been nearly 4 degrees below the average, and, with the exception of 1912, it was the coldest September since 1877. The first week was exceptionally cold for the season, the thermometer on the 5th not exceeding 52.7 deg. On 16 days the thermometer failed to reach 60 deg. Rain fell on 20 days, and the month's total was nearly an inch above the average. Sunshine was 35 hours deficient, and there were 12 days on which less than two hours' sunshine was registered. North-westerly winds greatly predominated, particularly in the early part of the month, and on the night of the 19th there was a gale of considerable violence.

OCTOBER

Although changeable at times the weather of October was decidedly drier and finer than that of September. In the middle of the month there were some chilly days, and on the morning of the 14th a slight shower of snow. A windy period occurred between the 20th and 24th, with gales on the 20th and 23rd (the latter severe), accompanied by heavy rains. The latter part of the month was very fine and warm for the season, the thermometer on the 30th reaching 60.4 deg., and on the 31st 62.2 deg., which was 9 deg. warmer than the previous Midsummer Day. Very low barometer readings

accompanied the gale of the 23rd, the mercury descending to 28.75 ins. The month's rainfall was about half the average. Gardens were unusually gay for the time of year at the close of the month, the display of roses being very exceptional.

NOVEMBER

Fine, warm weather continued until the 10th, temperature rising to 60.2 deg. on the 3rd. But an abrupt change followed, and a sharp frost on the 10th turned summer into winter in a few hours, and was very destructive to vegetation. Cold weather continued until the end of the month, frosts in the screen occurring on 13 nights and on the ground on 19 nights. The mean temperature of the first nine days was 48.5 deg., that of the remainder of the month 37 deg. Rain fell on several days in the early part of the month, followed by a dry period, 12th to 21st, after which exceptionally heavy snowfalls occurred almost daily, the depth of snow on the level on the 29th being 7½ inches. Such a wintry visitation in November is a rare occurrence, there having been nothing like it since 1890, although there were considerable falls of snow in the Novembers of 1904, 1919, and 1921. The month's total rainfall was 1.15 in. above the average. Winds were mainly from a northerly or north-westerly quarter, and were very rough in the squalls of snow on the 25th, some of the gusts at Gorleston equalling 66 miles an hour.

DECEMBER

Wintry weather continued until Christmas, with severe frosts, the thermometer on the night of the 15th falling to 16.2 deg. in the screen and to 12 deg. on the surface of the snow, this being the sharpest night recorded in any December since 1906. A great change occurred at Christmas, when the wind, which had been mainly north-westerly, settled into the south-west quarter, the result of deep depressions arriving from the Atlantic, bringing a change to great warmth for the time of year, the maximum on December 29th having been 57.2 deg., or 4 deg. higher than that of the previous Midsummer Day. Gales of considerable violence occurred at this time, that on the night of the 29th being very severe.

The Seasons.

Tables of Mean Temperature and Rainfall of the four Seasons of 1925 (including December, 1924, but excluding December, 1925) and compared with those of the five previous years, and with the average.

Temperature

Seasons	1920	1921	1922	1923	1924	1925	Average for 30 years.	Departure of 1925 from average
	degrees	degrees	degrees	degrees	degrees	degrees	degrees	degrees
Winter -	41·2	41·7	40·2	41·3	37·3	41·6	38·4	+ 3·2
Spring -	50·0	49·6	46·9	47·3	46·7	47·6	46·7	+ 0·9
Summer -	58·9	62·1	57·9	60·3	60·2	61·5	60·2	+ 1·3
Autumn -	50·2	51·3	48·4	47·8	51·2	48·2	50·1	—1·9
Year - Jan. to Dec.	50·0	51·5	48·3	48·7	49·4	49·2	48·8	+ 0·4

Rainfall

Seasons	1920	1921	1922	1923	1924	1925	Average for 35 years.	Departure of 1925 from average
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Winter -	8·12	5·58	9·86	8·07	7·40	6·06	6·21	—0·15
Spring -	6·61	4·17	5·32	3·95	6·58	6·31	5·55	+0·76
Summer -	7·34	2·57	10·54	6·45	6·08	4·65	6·89	—2·24
Autumn -	3·76	4·65	6·06	8·84	10·86	8·51	7·83	+0·68
Year - Jan. to Dec.	24·00	15·71	32·49	27·74	30·77	25·10	26·48	—1·38

The winter of 1924-5 was 3 deg. above normal, and was the mildest winter since 1920-21, the spring was slightly above, the summer, 1.3 deg. above, and the autumn nearly 2 deg. below the average. The winter's rainfall was fairly normal, and that of the spring ·76 inch above. The summer was 2.26 inches below, chiefly owing to the dry June, and the autumn 0.68 inches in excess of the mean.

The Year

The outstanding features of the year 1925 were: (1) The extremely mild winter; (2) the absence of snow, the first fall of the winter having occurred as late as 21st February; (3) the number of early morning thunderstorms in May; (4) the drought and heat of the first three weeks of June and first 25 days of July; (5) the cold period of the last week of June, when, on Midsummer Day, the maximum temperature was 1.6 deg. colder than that of January 2nd and 4 deg. colder than that of December 29th; (6) the generally unsettled character of the weather from July 25th to the end of the year (excepting a period at the end of October and the beginning of November); (7) the unusually cold September; (8) the spell of wintry weather with exceptional snow-storms from November 25th to Christmas; and (9) the great outburst of mildness, accompanied by strong gales of wind, in the last week of the year. The mean temperature of the year 49.2 deg., was 0.4 deg. above normal. January, February, May, June, July, August, and October, were all more or less warmer than usual. April was normal, and the remaining months all colder than the average. The rainfall was 1.32 in. deficient, the wettest month having been November with 3.72 ins. of rain, and June the driest with only 0.61 in. The year's total sunshine was just 40 hours deficient, May and June being the sunniest months with 236 and 241 hours respectively. Mr. J. H. Willis has again been good enough to supply the monthly readings of sunshine.

MR. PRESTON'S METEOROLOGICAL RECORDS FOR 1925

Month 1925	BAROMETER					THERMOMETER					HYGRO-METER	SUN-SHINE	RAINFALL		WIND								
	Highest	Date	Lowest	Date	Mean	Highest	Date	Lowest	Date	Mean	Mean Relative Humidity 9 a.m	Hours	Inches	No. of Days	Direction and Days								Mean estimat'd force
															N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	
	in.		in.		in.	°		°		°	%												
Jan.	30.74	19	29.17	2	30.174	54.8	2	26.3	16	41.0	86	58.9	1.07	11	0	0	3	4	8	8	5	3	3.3
Feb.	30.41	4	28.71	26	29.300	54.1	10	23.7	22	41.1	86	65.3	2.03	19	1	0	2	3	5	7	6	4	3.9
March	30.49	16,18	29.53	8	30.094	53.9	16	24.4	13	40.9	82	95.4	1.76	19	3	8	1	0	1	3	4	11	3.2
April	30.20	20,21	29.29	16	29.787	62.0	13	26.1	4	46.3	77	113.1	2.50	21	2	4	2	6	2	5	4	5	3.1
May	30.19	14	29.27	28	29.777	80.0	16	36.5	2	55.6	72	235.8	2.05	16	2	3	2	3	8	8	5	0	3.3
June	30.41	10	29.82	21	30.085	83.2	11	43.7	2	58.6	70	241.3	0.61	8	8	2	4	2	0	2	5	7	3.5
July	30.31	13	29.44	27	29.889	87.2	22	48.0	8	64.0	72	211.9	1.68	9	1	2	5	6	1	9	3	4	3.1
Aug.	30.32	15	29.56	23	29.938	77.0	17, 31	45.9	26	61.8	78	161.2	2.36	17	0	2	3	4	5	4	4	9	2.9
Sept.	30.37	13	29.17	22	29.899	69.2	30	41.2	13	53.2	82	114.2	3.09	20	3	0	0	1	6	3	5	12	3.4
Oct.	30.50	9	28.75	23	29.892	68.0	6	32.2	17	50.9	87	101.9	1.70	14	7	3	0	2	7	3	4	5	2.8
Nov.	30.51	19	28.85	7	29.896	60.2	3	25.4	15	40.5	87	77.2	3.72	20	5	5	5	3	2	2	2	6	2.8
Dec.	30.58	4	28.57	20	29.694	57.2	29	16.2	16	36.6	89	67.0	2.53	24	1	3	1	2	3	5	6	10	3.
Means					29.894					49.2	81												3.2
Extremes & Totals.	30.74	Jan. 19	28.57	Dec. 20		87.2	July 22	16.2	Dec. 16			1543 2	25.10	198	33	32	28	36	48	59	53	76	

V

THE HERRING FISHERY OF 1925

By Arthur H. Patterson

The Yarmouth Herring Voyage of 1925 proved a great disappointment to those engaged in it ; the quantity of herrings taken was considerably smaller than in 1924, and the quality generally unsatisfactory. In tabulating this year's catches I have consulted the figures issued in the excellent daily reports of the *Eastern Daily Press ;* and have noted that the total landings, up to December 12th (after which date the averages fall off considerably to *nil*), amounted to 477,264 crans, a decline from the previous year of considerably over 170,000 crans—or, in old-time measurement, 17,000 lasts.

On writing to the Commissioners at Yarmouth as to these figures, I received a note in reply, that " the correct fishing figures for 1924 and 1925 are as follow :—

1924	...	...	654,982 crans
1925	...	...	479,293 ,,

I can only assume that the figures you quote as coming from the ' E.D.P.' were up to a different period.

Yours faithfully,

L. A. C."

The greatest landing in one day was on October 29th, when 684 boats brought in 13,724 crans ; the heaviest week—from October 26th to October 31st—accounted for a huge landing of 143,535 crans. The largest individual " shot " (one hauling) was on October 22nd, when 250 crans, roughly over a quarter of a million fish, were netted by one vessel. The largest record made by a single boat, the " Norford Suffling," was a catch of 167 crans, which realised £431. She had enmeshed more herrings than could be cleared from the nets, and the residue was transferred to a very appropriately named boat, " The Golden Chance." This " residue " realised £216, making a total netting by the " Norford Suffling " of herrings worth £647. At the time this " miraculous draught " was being handled other boats " struck " such dense shoals that the weight of fish broke the nets adrift, when nets and fish sank to the bottom of the sea and were irretrievably lost.

The vessels engaged on the fishery numbered 757 Scotch drifters, 125 Yarmouth boats, 19 from North Shields, Irish 3, Manx 1, Middlesborough 1, Scarborough 1 ; a total of 897 boats. Most of these were steam driven, but an increasing number are resorting to motor power. The earnings of the Yarmouth boats ranged from £2,500 downwards, with an average of £1,500 ; the Scotchmen grossed from £2,100 down to £800. It may be remarked that Scotchmen do not prosecute the fishing on Sundays, and are greater students of the barometer.

Some 4,000 Scotch girls were employed in the gutting yards and plots, but experienced a very short and somewhat lean season.

" The value at first hand," to quote from a very detailed and statistical summary of the fishing, " of herrings this season is between £800,000 and £900,000 " ; which meant a great money circulation, arising from handling and distributing the catch, among the various trades connected with the industry. An interesting item refers to the persons employed ; there were some 842 coopers, 450 kipperers, 350 carters, and over 100 labourers. One report gives the total of shore-workers at some 2,500.

A new and evidently popular traffic has lately developed, known as the Freshing Trade, a demand having sprung up on the Continent for fresh, uncured herrings, viz. : fish sprinkled with salt and ice. More accommodation is necessary, and will no doubt be given by the Yarmouth and Lowestoft authorities, who appear alive to the possibilities.

" Reds "—smoked herrings—are still in repute in countries bordering on the Mediterranean. The pickled herring trade (fish barrelled in brine) of 1924 was very disappointing and unsatisfactory. High prices were rather recklessly given by speculative fish merchants, and the " pickles," owing to adverse monetary conditions abroad, notably in Soviet Russia, were not cleared without sacrifice until well into 1925. Some losses through long delay occurred by deterioration. The year 1925 saw the merchants more wary, both as to quantities, and the prices given for the herrings. 422,000 barrels represent the " pickles " of 1925. By December 5th Yarmouth had shipped abroad 197,500 barrels to such ports as Danzig, which took 44,800 barrels ; Stettin, 36,800 ; Königsberg,

18,600; Riga, 18,300. Exports also went to Reval, Helsingfors, Wyberg, Duisberg, Hamburg, Rotterdam, Ghent, Ostend, and Scheveningen. In all probability many barrels leaked through into Russia, where the poorer folk highly prize a cut of solid-salted herring.

The fishing did not pass without some losses of gear and human life. Two fishermen were drowned, and a Scotch skipper died from the effects of immersion, having been rescued from sinking by his gallant son. In the old days of sailing craft, of a far smaller tonnage, the loss of life was occasionally serious, as they could not run into port to escape sudden gales of wind, as at the present day of steam and petrol. And "wireless" has been of great service.

GENERAL REMARKS

A few items from my Notes taken from time to time may be of some interest. Two large herrings were brought into Yarmouth on June 4th that had been taken by 'longshore boats, the largest one 15 inches in length. 'Longshores average 10 inches in length, girth $5\frac{1}{2}$ inches; a "full" herring in the autumnal fishing should be $11\frac{1}{2}$ inches long. Mr. de Caux's largest fish, of which he had auctioned many millions, was $15\frac{1}{2}$ inches. My two largest have been:

> Dec., 1895, length 15 inches, girth 7 inches, weight $14\frac{1}{2}$ ounces. Dec., 1900, length $15\frac{1}{2}$ inches, girth $7\frac{1}{2}$ inches, weight $14\frac{1}{2}$ ounces.

The quality of the late summer 'longshores was very poor, and they were scant of oil; to me they had a starved appearance.

Only 5 per cent. of the herring catch is used for home consumption. It is very desirable that the cost of carriage should be considerably lowered, so that inland folks, with cheap and prompt delivery, could be served with one of the daintiest of our common fishes. I have tried herrings procured at Norwich fish shops, moist and flabby, and very indifferent in flavour. Fishmongers seem continually to be watering them.

'Longshore fishing in late September and early October by motor open boats, and shrimp boats, with three men as a crew, was a small but distinctly interesting experiment. The

fish were close inshore, and good catches were made. I examined some examples. They were fresh and glistening, as if carved of silver. Some were 9 inches in length, 4½ inches in circumference, and 4 inches in depth, weighing 5½ ounces, before gutting.

On October 7th I had a chat with an intelligent shrimper, named Ward, whose boat, a 6-tonner, had been cleared of shrimp trawl and dredges, and turned into a "'longshorer." His was one of a dozen boats working. He left port usually at 4 p.m., got to his ground and shot his nets by 6 o'clock, taking them inboard at 7.30 p.m. After clearing them he shot them again, and got most of his fish after dark, especially on high water slack. He shot his nets starting from the breakers, and going out diagonally. He had 22 nets in his little "fleet," each net of 60 yards, with a depth of 8 score meshes; making, when "shot" a wall ten feet deep. It took three-quarters of an hour to get them in; twice that time if rough or blustering. He caught little else beside herrings; occasionally a few gurnards, small dogfish, odd mackerel, and occasionally a salmon-trout; even a flat fish, and a "roker" (Thornback Ray).

October 14th.—All Scotch boats in. So little fish landed that not a Scotch girl was gutting. On the night of the 19th they had shot their nets with a northerly wind, when suddenly it veered to the south'ard. They began to rush in towards midnight, having scurried up their nets. On the 20th the river was packed by boats, and they spent the day overhauling their tangled nets.

The fashions even of Scotch fishermen and girls change. Rarely now does one see a Scotchman with a beard, and seldom an old man, unless it be that a small moustache camouflages his age. The girls are almost all bobbed; undoubtedly a sanely sanitary innovation. On Sundays they parade the streets in up-to-date attire, and gay, expensive stockings. They have also taken to riding to their work, motor lorries, with enclosing rails, taking them to and from their lodgings in batches, standing erect. Vivacious, raw-boned lassies!

Early in October two "swills" of large-piked dogfish were enmeshed in the nets of one boat. They were sold on the wharf and served up later in certain fried fish shops.

One other innovation is worthy of note, as this example will be followed undoubtedly in all newly-erected fish-houses. The old-time ventilation slides, working on the principle of railway carriage doors, are being superseded by cowls, such as have for decades been seen upon maltings ; and in one up-to-date fish-house a central fire (of billet) has been used, with pipes leading from the smoke-chamber into any special or all departments and shut off as occasion demands, a vast economy of fuel, and a great advantage to the hands who work in the "lofts."

I have to thank the Lowestoft Authorities for the following :—

LOWESTOFT RETURNS.

	English Drifters.	Visiting Drifters.	
	Steam.	Steam.	Motor.
No. of Fishing Vessels engaged at Lowestoft	250	177	36
No. of Crans landed at Lowestoft	333,326		
Estimated Value ...	£594,000		

Yours faithfully,

(Signed) GEORGE T. ATKINSON,

District Inspector of Fisheries.

VI

WILD BIRD PROTECTION IN NORFOLK IN 1926

REPORT OF THE COMMITTEE

THE two outstanding features in connexion with the protection of birds in Norfolk during the past year are :—

(1) The creation of a new Bird Sanctuary in the County, reference to which will be found on p. 189.

(2) The prosecution of a well-known egg collector, Mr. E. P. Chance, for aiding and abetting in the taking of Crossbills' eggs from an area within the County. The

case being one of more than ordinary importance, we have put it on record in this Report.

The principal agents upon whom this and similar societies depend for carrying out their instructions in the matter of bird protection are Watchers. These are local men of good character and reliability—men who are interested in their work, who are prepared cheerfully to face discomforts, and who, above all, will be loyal to their employers under all circumstances. But it has always to be remembered that the Bird Watcher, as a watcher, has no legal powers, unless such are specially conferred upon him. We have always realised this, and it is therefore with satisfaction that we are able to report that during the year the Chief Constable of Norfolk, in response to our request, has made three of our watchers Special Constables. This confers upon them powers little inferior to those of the ordinary police constable, and in the matter of right of search, etc., the advantage of these is obvious. It is of course equally incumbent upon the watcher not to abuse such powers.

As the guardians of wild birds, especially during their period of nesting, we are inclined to look a little askance at the numerous requests to take photographs which we receive from bird photographers. At the same time, we unhesitatingly congratulate Mr. Humphrey Boardman, of Ludham, on having obtained this summer a unique series of photographs of the Bittern at its nest, taken in Norfolk. With his permission we reproduce two of these. We are also indebted to Miss Grace Gay for making drawings of a Bittern and of a Ruff which will in future be printed on the cover of this Report.

A New Bird-Breeding Sanctuary for Norfolk

Through the public-spirited enterprise of a few ornithologists, and of one in particular, the partially-inundated area of marshland between the village of Cley and the boundary bank of Salthouse Broad—commonly known as the Cley Marshes—together with a building site on the mainland overlooking the marshes, were purchased at public auction in Norwich on March 6th, 1926, from the Executors of A. W. Cozens-Hardy of Cley Hall, the previous owner, for the sum of £5,160.

These marshes, of 407 acres, have been protected from the sea by a concrete sea-wall, built by one of the Cozens-Hardy family many years ago. On the night of December 31st, 1921, as the result of an abnormally high tide, a large part of this wall was demolished and the marshes became flooded. In this condition of partial inundation they have remained, and have been the resort of numerous ducks and other wild fowl at all seasons of the year. It soon became obvious to those who visited the marshes during the summer months that, if left undisturbed during the breeding season, they would provide most attractive nesting sites for birds of a considerable number of species. For example, in 1923, 180 Sandwich Terns' nests were found on one small section of the marsh, and in 1922 Mr. A. W. Boyd found a Ruff's nest with four eggs (*British Birds*, Vol. XVI., p. 86). There are long stretches of reed-beds on the marsh, and as the Spoonbill is a common visitor during the summer it is perhaps not too much to hope that it will ultimately be tempted to nest there. The numerous shallow pools would apparently provide ideal feeding-grounds for the Avocet, a bird which, at the beginning of last century, nested on the adjacent Salthouse marshes.

Bearing in mind all these, and many other, facts and possibilities in connexion with the marshes, the purchasers of the property resolved that it should remain as a bird breeding sanctuary for all time; and, with this end in view, have made arrangements to hand it over to a newly-constituted "Norfolk Naturalists Trust." In our next Report we hope to be in a position to give further details as to the future conduct and management of the new Sanctuary.

Prosecution under the Wild Birds Protection Act, 1894

For some considerable time the Committee has had strong suspicions that the nests of a flourishing colony of Crossbills in the neighbourhood of Thetford were being persistently robbed by collectors. It is, notoriously, extremely difficult to obtain evidence of such egg-stealing, that is evidence such as will secure a conviction in a court of law; and it was by a mere accident that such information was obtained by the

honorary secretary on March 7th, 1926. On the afternoon of that day he visited this colony with friends, when a total stranger came up to him on the high road and offered to show him Crossbills' nests and, what was more inexplicable, offered to sell him a clutch of eggs which the stranger had taken that morning from a nest in a Scotch fir overhanging the road. Furthermore, he climbed the tree for the nest and gave it to Dr. Long.

After bargaining, the clutch of eggs was purchased for fifteen shillings. This man, Albert Wyatt, a farm bailiff, who resided in a cottage in the wood, further volunteered the information that he was sending clutches of Crossbills' eggs every week to a very good customer in London, Mr. Chance by name. He produced a box of five clutches which would be despatched to London from Thetford by a certain train in two days' time.

This information was handed on to the Norfolk police, who made further enquiries, with the result that on March 9th Wyatt was seen to put on a London train at Thetford a parcel, which was intercepted at Liverpool Street and found to contain twenty-three Crossbills' eggs; it was addressed to Mr. Chance of St. Helen's Place, London. The parcel was received at Liverpool Street by a clerk from Mr. Chance's office, who stated that he had received instructions from his employer to collect the parcel of eggs. He was stopped by a police officer, to whom he handed the parcel.

At the East Harling Bench of Magistrates on April 26th, with Lord Albemarle in the chair, Albert Wyatt was fined £6 19s. 0d., including costs, for taking three Crossbills' eggs on March 7th, and twenty-four similar eggs on divers dates about March 9th. At the same Court Edgar P. Chance, of London, the well-known author of "The Cuckoo's Secret," who was not present and was not represented, was fined £13 10s. 0d. and £9 2s. 0d. costs for aiding and abetting Wyatt. The defence put forward by Wyatt's solicitor was that the eggs were those of the Greenfinch, and various writers were quoted to support his contention that it is impossible to differentiate between the eggs of these two birds. However, he omitted to refer to the fact, obviously well-known to the Bench, that Greenfinches

do not nest in colonies in Scotch Fir trees, nor are they in the habit of laying their eggs as early in the year as the first week in March.

After the help of the police had been so readily given in the case against Mr. Chance, it was a little galling to find that they declined to take proceedings against a man who, in the month of August, shot a Razorbill on the north Norfolk coast —a bird protected by the Norfolk County Council between March 1st and September 1st. There was no lack of evidence, but his plea was that he mistook the bird for a duck. Our only comment is that if strangers come into Norfolk to shoot ducks in August they should first familiarise themselves with the differences between ducks and divers.

Cley and Salthouse

During the greater part of the summer there was a considerable amount of water on both these areas, augmented by a high tide which came through the breach in the sea-wall on July 25th. On May 16th the writer found about one hundred Sandwich Terns in occupation of an island on Salthouse Broad, and by the 24th Holman, the keeper, had found forty-five nests with eggs. However, these eggs were all destroyed later, apparently by rats as the broken egg shells were left on the ground. Most of these birds then left. On June 19th the writer found five more nests on the same island, and these all hatched off. From eighty to one hundred pairs of common Terns nested on the Broad.

Owing to the excess of water on the Cley marshes and the absence of a boat, it was impossible to make an inventory of the nests on this new sanctuary. Nor does that much matter. The main object was achieved, namely, the keeping of the ground undisturbed from all human intruders throughout the nesting season. Many ornithologists derived much pleasure from watching the birds from the East Bank, and during most weeks between May and August were rewarded by the sight of a Spoonbill confidently feeding, or preening its feathers, usually in the company of Herons.

William Bishop, of Cley, has been appointed Watcher for these marshes, and was on duty all the summer.

Blakeney Point

As is well known, this is the property of the National Trust, and for many years Robert Pinchen has acted as Watcher —jointly for the Trust and our own Society. During the breeding season he resides at the Old Life-boat House on the Point. For an unknown period Terns have nested in varying numbers on this exposed foreshore and, in addition, a few other species of sea birds nest on the property.

During the past season eight pairs of Oyster-catchers nested and, as has been the case for several years, two birds laid in one nest—always the same nest. There were about the usual number of Redshanks' nests, and rather more than usual of the Ringed Plover.

Five species of Terns nested on the Point this year. The Common Tern nests in two colonies of several hundred birds in each ; the one, the larger colony, on the newly-formed Far Point, where young dunes are rapidly forming on the shingle ; the other, in the neighbourhood of Long Low—the nests here being partly on the shingle and partly among dunes of older formation. During the last year or so there has been a tendency for the birds to migrate from the second to the first of these nesting sites.

In 1925, for reasons unexplained, only eight pairs of Sandwich Terns nested on Blakeney Point ; whereas this year the birds returned in greater numbers, and one hundred nests were counted—all in the young dunes on the Far Point. There was a good hatching, and most of the young got away.

After a visit to the Cley Marshes and to Blakeney Point with the writer on June 20th, Dr. Norman F. Ticehurst wrote :— " In thanking you once more for a delightful visit I should like to say how much I enjoyed the day at Blakeney and Cley and to congratulate you on the fine colonies of terns that we saw.

" It was a great pleasure to me to make the acquaintance, for the first time, of Sandwich and Roseate Terns. I was astonished to find how little larger on the wing the former looked than the Common Terns. There were one or two points that struck me with regard to your Common Terns, as compared with other terneries I have visited. Firstly, the

greater tameness of your birds; never before have I been able to watch terns down to their nests at such short distances and with an entire lack of cover. Secondly, the greater crowding; I have seen some Arctic colonies almost as thick on the ground, but not Common Terns. This seems strange, as your birds have been protected for years and there is ample accommodation for a further spread. Thirdly, the large proportion of well-made nests. Of course your birds are nesting on sand and a good nest-hollow is easily made, but I think a far larger proportion make a more considerable attempt at building than is the case in many other colonies. Fourthly, the ease with which nests could be found; but of course this is accounted for by the accident of site, numbers, crowding, and nest formation. Most of my previous experience has been on the shingle of Dungeness, where conditions are so entirely different that this last point strikes me perhaps more forcibly than it would many others.

"It seems very curious that with the considerable adaptability of the species to varying nesting sites the majority of your birds should be so very conservative in sticking to one particular dune formation, particularly as it happens to be the most exposed both to winds and rain, and also to the risk of abnormal tides. It is peculiarly vexing that when so much care is taken over the protection of these birds the infantile mortality should be, at times, so high—an accident that might to so large an extent be avoided, but for this extreme conservatism.

"I shall look forward with considerable pleasure to paying another visit to your Cley reservation. It struck me as an ideal spot from which to watch passing waders, and your list of visitors should speedily become a long one. As time goes on and it reverts more and more to natural conditions and the cattle no longer tramp over it, you ought to get some interesting breeding species there also; and I trust to hear within quite a few years of the return of the Ruff and Black Tern to what was no doubt a former breeding-haunt."

Scolt Head Island

As foreshadowed in our last Report, a whole-time Watcher in the person of Charles Chestney, of Brancaster Staithe, has been

appointed to look after this island sanctuary, and he has been on duty since November, 1925. When it is remembered that the island is four miles long, that it is made up of extensive saltings, long exposed shingle beaches and extensive dune systems, it can be readily understood that it requires an active man of sound and vigorous constitution to fill the duties of this post. During the summer months his whole time is occupied in looking after the nesting birds; during the remainder of the year there is endless work to be done in the matter of dune conservation, in the planting, under supervision, of trees and shrubs to make the island more attractive to passerine birds, and in preventing poaching. When weather-bound he has the hut for shelter, or for sleeping; but in the ordinary way the hut is reserved for naturalists who are anxious to carry out scientific investigations. During the past year it has been put to such use on several occasions.

The ternery on Scolt Head is very comparable to that on Blakeney Point, that is to say, the birds nest on the extreme west end of the island, where a system of young dunes is in process of formation. On June 14th of this year the writer went round the ternery to make a census, and counted 515 nests of the Sandwich Tern. Of these approximately three-quarters contained two eggs, six nests contained three eggs, the rest one egg. During the next week several more eggs were laid. At a subsequent visit, on July 4th, the watcher had a sad tale to tell. During the previous week the young terns had been dying in large numbers, and, as was obvious, were still dying within about twenty-four hours of being hatched. This very high mortality just at the period when the birds were all hatching off resulted, as I estimated from this and subsequent visits, in the premature death of from 50 to 75 per cent. of all the young Sandwich Terns in the colony. Starvation appeared to be the explanation, due to the fact that the herring "syle" had not yet come in-shore.

Among the Common Terns, which are about equal in number to the Sandwich, the mortality was not quite so great, because the main hatching took place about a week or so later, by which time the young fry had come into the shallower waters so that the parents had no longer to fly miles out to sea to procure food. No such mortality was noticed among the chicks of the Little Terns.

There was no evidence this year of either the Roseate or the Arctic Tern nesting on the island.

Ringed Plovers nested in large numbers, and there were six Oyster-catchers' nests, all of which hatched out.

Sheld-Ducks nest in increasing numbers, and there must have been from fifty to one hundred pairs breeding on the island during this past season.

For many years a pair of Short-eared Owls have almost certainly nested in the dense *Suaeda* bushes on a certain raised part of the Saltings, and although the nest was not found this year there is no doubt but that the birds were again nesting in the same part of the marsh. When the writer was looking for the nest on one very wet afternoon in June, 1926, with the old birds soaring round overhead, evidence of their food supply was obtained from the recently-killed remains of Little Terns and of one Redshank which were found near to where the nest was considered to be.

Although a considerable number of interested people visited the island during the summer, there has been no evidence of any interference with the nesting birds.

Wolferton

Since the publication of our last Report there has passed away in the person of Colonel George Cresswell, M.V.O., one of the most active supporters of Wild Birds Protection in Norfolk. Some twenty years ago he started, with H.M. the King as Patron, the "Wolferton Wild Birds' Protection Society," and up to the time of its amalgamation with the other Bird Protection societies in the county, in 1921, he made himself responsible for collecting the funds and for supervising, by frequent visits from his home at Hunstanton, the Wolferton nesting ground. He may well be described as one of the first Bird Watchers in the county, and we have a high regard for his memory.

Great changes are taking place at this Wolferton nesting ground on the edge of the Wash. The shingle, in which the birds lay their eggs, has apparently been purchased by a company who are removing it by thousands of tons annually for the manufacture, it is said, of cement and concrete. It is thus only a matter of time for the whole breeding ground to

disappear. When we visited it at the end of June this year Bridges, one of the watchers, stated that he had found about sixty nests of the Common Tern and about twenty of the Little Tern. The large majority of these nests were trampled on by the horses and cattle that roam over the ground. Under the conditions now prevailing it would hardly seem worth while to continue to " protect " the ground.

Mr. Tracy's Bird Sanctuary at South Wootton

In previous reports we have referred to the some six to seven acres of woodland at South Wootton, near King's Lynn, which Mr. N. Tracy has been gradually making more and more attractive to nesting birds, so that it will be of interest to put on record his experiences of the past season. In a letter he says :—

" Taking it all round, I think this has been a very good year for the birds in this district. In spite of continued sharp frost between January the 12th and 17th, I do not think the birds suffered much, and I saw only one dead Redwing and one dead Blackbird. Wild Geese were numerous on the Wootton marshes throughout the winter.

" On February 20th I watched a hen Crossbill building a nest ; she had only just started and had placed in position about six Scotch fir twigs as a foundation. On the 27th she had finished building and was sitting. Later, I found two other nests in the district. It was in 1910 that I found the first nest in this part of Norfolk, but, judging by the number of freshly-worked cones which I found in various parts of the county this spring, it would seem that the Crossbill is more widely distributed than is generally supposed.

The following are the dates of arrival of some of the spring migrants, as noted by me :—

Wheatear (North Wootton)	March	20th
Chiffchaff (North Wootton)	,,	30th
Sedge-Warbler (Hickling Broad) ...	April	2nd
Swallow (Hickling Broad)	,,	4th
Willow Wren (Hickling Broad) ...	,,	5th
Redstart (South Wootton)	,,	7th
Whinchat (North Wootton)	,,	8th
Common Whitethroat (South Wootton)	,,	9th

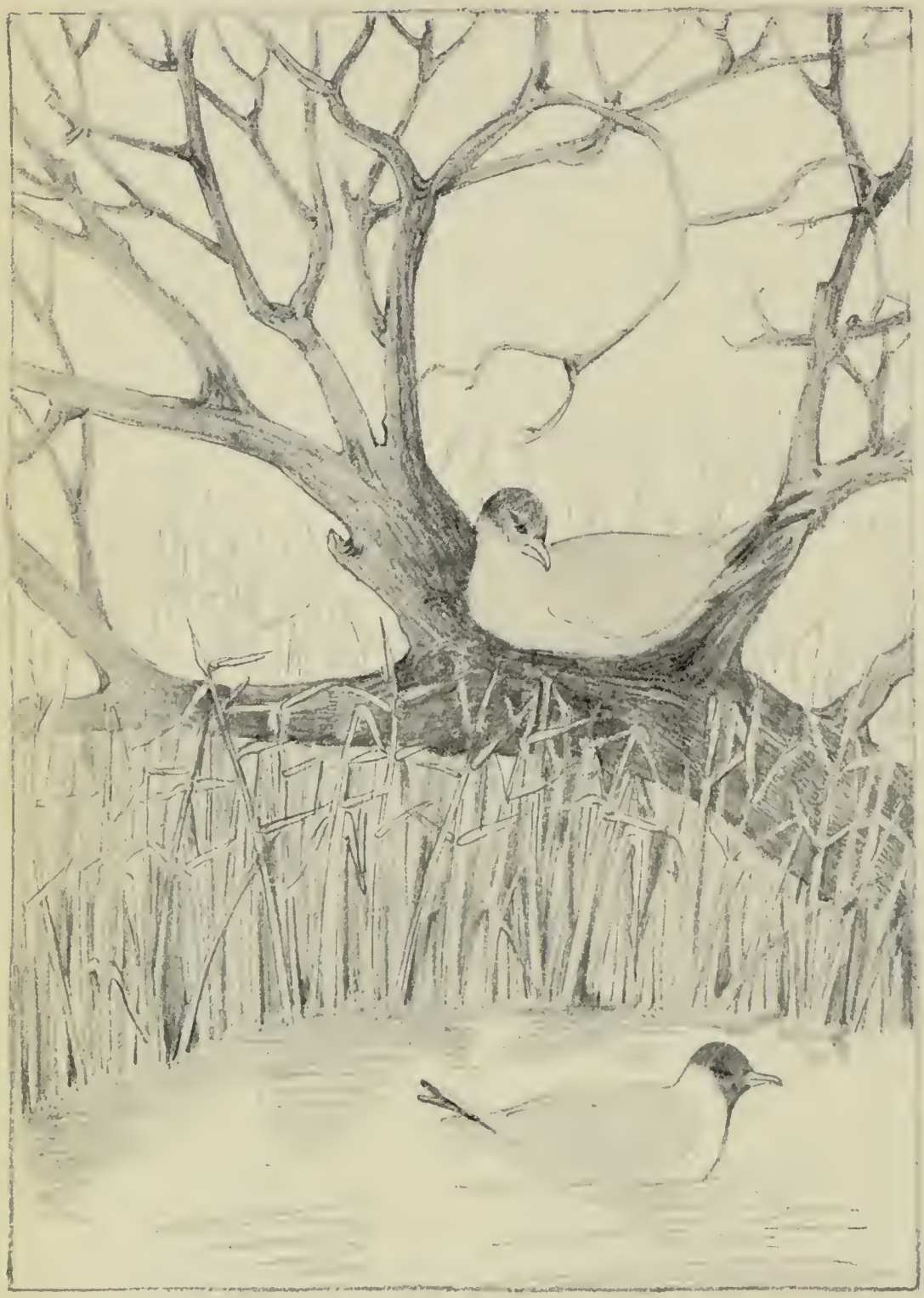
Yellow Wagtail (North Wootton) ...	April	9th
Tree Pipit (Castle Rising)	,,	10th
Blackcap (South Wootton)	,,	10th
Nightingale (South Wootton) ...	,,	13th
Stone-Curlew (Roydon Fen)	,,	13th
Sand-Martin (Roydon Fen)	,,	14th
Swallow and Martin (South Wootton)	,,	18th
Cuckoo (South Wootton)	,,	20th
Grasshopper Warbler (Witton) ...	,,	27th
Reed-Warbler (Witton)	,,	27th
Lesser Whitethroat (Witton)	,,	28th
Wood-Wren (South Wootton)	May	3rd
Garden-Warbler (North Wootton) ...	,,	3rd

" Amongst these spring migrants the following were certainly more numerous than usual this year :—Wheatear, Yellow Wagtail, Tree-Pipit, Willow-Wren, Chiffchaff, Common Whitethroat, Garden Warbler and Spotted Flycatcher. The Wryneck I hardly ever hear in this district, and the Corncake has vanished ; it is quite six years since I last heard one. Among the resident birds there seems to be a great increase in the number of Lesser Redpolls. I am glad to say that the Wood-Lark has extended its range to this district, and I estimate that there are about six pairs in the immediate neighbourhood of my wood. The following birds nested in my wood this year, the figures in brackets being the number of nests found.

Great Tit (4)	Song-Thrush (5)
Blue-Tit (4)	Mistle-Thrush (8)
Cole-Tit (2)	Chaffinch (20)
Marsh-Tit (1)	Wood-Pigeon (6)
Long-tailed Tit (1)	Redstart (6)
Tree-creeper (4)	Pied Wagtail (2)
Nuthatch (1) two broods	Hedge-Sparrow (1)
Starling (1)	Spotted Flycatcher (2)
Robin (2)	Tree-Pipit (1)
Wren (3)	Lesser Redpoll (3)
Willow-Wren (8)	Turtle-Dove (1)
Blackbird (4)	Goldcrest (1)

a total of 91 nests.

" I watched four pairs of Wood-Wrens near my wood this year and found one nest.



Black-headed Gull on its nest in an Alder Tree
on Scoulton Mere, May 30th, 1926

" Two of the pairs of Redstarts had second broods, the hen birds building the new nests while the first broods were still in the old ones, and laying the first egg about the day after the young had left the first nest. The work of looking after the first brood seems to devolve upon the cock, who keeps the young in the neighbourhood of the nest for the first week or two and then takes them out on to the open heath outside the wood. I believe the brilliant under-parts of the Redstart must be a protection to them against larger birds, for I never notice any appreciable diminution in the broods of the young, though amongst many other birds the mortality during the first week or so of life would seem to be as high as fifty per cent.

" Three years ago a Greater Spotted Woodpecker excavated a nesting-hole in a dead birch in the wood, when a pair of Redstarts, which had already started to build in a bark lean-to, took a fancy to this hole and proceeded to turn out the Woodpecker. This they did by flying up to the latter when it was on the tree by the hole and hovering in front of it and flashing their under-parts in its face. Each time they did this the Woodpecker let out a squawk of alarm and flew away. The Redstarts immediately began to carry large pieces of moss into the hole, and when the Woodpecker returned they repeated their former procedure and drove it away again. After this the Woodpecker left them alone, but after carrying a few more pieces of moss into the hole the Redstarts went back to their original nest and hatched their brood in it. The Woodpecker then returned to its hole and removed the moss, but did not use the hole for its nest though the cock bird used to roost there at night. I have seen Redstarts drive a Starling away from their nesting box in the same manner. There were four pairs of Redstarts immediately outside my wood and other pairs seemed to be in all the surrounding woods.

" The Nuthatch was a new nesting bird with me this year. A pair were attracted to the wood during the winter by monkey nuts which I used to insert into the bark of two poplar trees near the house, and this pair remained to breed."

An Unusual Nesting-Site of the Black-Headed Gull

There would seem to be but few specific instances recorded in ornithological literature of the Black-headed Gull (*Larus*

ridibundus) building its nest in a tree, though when one remembers that the closely-allied species, Bonaparte's Gull (*L. Philadelphia* Ord.), of North America, almost invariably nests in trees, it is not so very surprising that *L. ridibundus* should occasionally be found doing the same.

In his classical description of the Scoulton Gullery (*Transactions of the Norfolk and Norwich Naturalists' Society*, Volume I., p 27, 1871-2), Stevenson says :—"A few years back a single pair built their nest on one of the small bushes of the island and reared their young, but this eccentricity was neither repeated by them, nor their example followed by others."

In the *Scottish Naturalist* for 1920, p. 77, W. Evans records "that a few nests occur annually in stunted fir-trees at the gullery at Threipmuir Reservoir," near Edinburgh.

During the past season a pair of gulls at Scoulton built their nest in the fork of a dead branch of an alder tree overhanging the water, on the edge of the "Hearth." There was a scanty lining of reed, but the fork itself practically formed the nest, which was about five feet above the level of the water, and when inspected by the writer on June 2nd was found to contain two live chicks in down. It was impossible to photograph the nest, but Miss Constance Gay kindly made a pencil drawing of it, from which our illustration is reproduced.

With the added liability this year for the wages of a whole-time Watcher on Scolt Head Island the Committee cannot but feel some anxiety for its future commitments, and appeals for an increase in its subscription list. Norfolk is doing its best to preserve its rich avifauna and to encourage the return of some of its lost birds, such as the Avocet, Ruff and Spoonbill. The "Sanctuary" method would seem to be the most likely means to adopt for attaining this object, and the results already achieved on Blakeney Point and Scolt Head, and in the Broads district, give encouragement to their view. But there are many details in connexion with this method which have yet to be developed and worked out in practice.

Those who are disposed to assist the Committee in this work should send their subscriptions to the undersigned, at 31, Surrey Street, Norwich.

Signed (on behalf of the Norfolk W.B.P. Committee),

SYDNEY H. LONG, *Hon. Sec.*

LIST OF SUBSCRIPTIONS AND DONATIONS TO THE NORFOLK WILD BIRDS PROTECTION FUND FOR 1926

	£	s.	d.
H.M. THE KING ...	3	3	0
H.R.H. THE PRINCE OF WALES, K.G. ...	2	2	0
Adcock E. D.... ...	1	1	0
Agnew C. G.	1	1	0
Allars R. W. E. ...	3	3	0
Allen J. L.	0	5	0
Allen J, W.	1	1	0
Andrews W. H. M. ...	0	10	0
Anonymous	0	10	0
Astley R. B.	2	2	0
Bacon Miss K. R. ...	10	0	0
Baker E. Stuart ...	3	3	0
Barclay F. H. ...	1	0	0
Barclay H. G. ...	2	2	0
Barnard Mrs. ...	1	1	0
Barrow Miss	0	10	6
Barry T. H.	1	1	0
Barry W. J.	1	1	0
Barton S. J., M.D. ...	1	1	0
Bedford Her Grace the Duchess of	2	2	0
Bell J. H.	0	10	0
Bidwell Edward ...	0	10	0
Blakeney Point Collecting Box ...	3	3	6
Boardman E. T. ...	1	0	0
Boileau Sir M., Bart.	1	1	0
Brash T.	2	2	0
Brittain H.	1	0	0
Brooks J. R.	1	1	0
Brown Edward ...	1	1	0
Brown Henry ...	1	1	0
Buckle Lt. Col. D. W.	1	1	0
Burrows R. B. ...	1	0	0
Burton S. H., F.R.C.S.	2	2	0
Buxton E. G. ...	2	2	0
Buxton G. F. ...	3	3	0
Buxton Walter L. ...	1	1	0
Byers J.	0	10	0
Byne Lt.-Col. R. M. ...	1	1	0
Calley Miss J. M. ...	5	0	0
Carr Mrs.	1	1	0
Carruthers D. ...	2	2	0
Cassie R. L.	0	10	0
Chamberlin Sir George	1	0	0
Chapman E. H. His Honour Judge ...	2	2	0
Christie J. A., M.P. ...	1	0	0
Coe Mrs A. E. ...	0	10	0
Coller G. A.	1	1	0
Collins W. G. ...	0	10	6
Carried forward	77	5	6

	£	s.	d.
Brought forward	77	5	6
Colomb Admiral P. H., C.B.	1	0	0
Colman Miss Ethel ...	1	1	0
Colman Miss Helen C.	1	1	0
Colman R. J. ...	1	1	0
Cooke A., F.R.C.S. ...	0	10	0
Cozens-Hardy A. ...	1	1	0
Deacon Dr. G. E. ...	1	1	0
Dew Mrs.	0	10	0
Dewar T. F., C.B., D.Sc., M.D. ...	0	10	0
De Worms C. ...	1	1	0
Doughty C. G. ...	1	1	0
Drury G. L.	0	10	6
Duncannon T. J. G. ...	3	3	0
E. B. S.	1	0	0
Edwards Francis ...	0	10	0
Ferrier Miss Judith ...	0	10	0
ffolkes Sir William, Bart.	1	1	0
Friedlein W.	0	10	6
Frisby G. E.	0	10	6
A Friend	0	10	0
Gadesden Miss ...	0	10	0
Gayner Dr. J. S. ...	1	1	0
Gay Miss C. E. ...	1	1	0
Gilbert H.	1	0	0
Giles C. C. T. ...	0	5	0
Gossage Col. W. W. ...	2	2	0
Graves Mrs.	1	1	0
Green Major E. A. Lycett	0	10	0
Gurdon E. T. ...	1	1	0
Gurney Q. E.... ...	1	1	0
Gurney J. H. ...	2	2	0
Gurney Robert ...	1	1	0
Gurney W. S. ...	1	1	0
Halls H. H.	1	0	0
Hannaford G. ...	2	2	0
Harcourt Miss J. Vernon	2	0	0
Harding J. Rudge ..	0	7	6
Hare Sir Ralph, Bart.	1	1	0
Harker W.	1	1	0
Harmer Bertrand ...	1	0	0
Harvey Miss C. ...	0	5	0
Haydon W.	0	5	0
Hayley J. N. ...	1	10	0
Herbert E. G. ...	1	1	0
Hill T. A. M.	1	1	0
Horsfall R. E.	0	10	0
Howard R. J. ...	0	10	0
Carried forward	122	17	6

	£	s.	d.
Brought forward	122	17	6
Irwin W.	0	5	0
Jago Cyril	0	10	0
Jones Sir Lawrence, Bart.	1	1	0
Ketton-Cremer, Wyndham C. ...	0	10	0
Kinder Rev. E. H. ...	1	1	0
Knight E.	1	0	0
Lee-Elliott Rev. D. L.	1	1	0
Lewis J. Spedan ...	2	2	0
Lloyd Captain L. ...	1	0	0
Long Miss	0	5	0
Long F.	0	5	0
Long S. H., M.D. ...	2	2	0
Lowe P. R.	2	0	0
Lucas Dr. Geoffrey ...	1	0	0
Mack H. P.	1	1	0
Macpherson A. Holte	1	1	0
Massingham H. J. ...	1	0	0
McKenna Mrs. Reginald	1	1	0
McKenzie Miss G. ...	0	10	0
McLean C.	2	10	0
Meade-Waldo E. G. B.	2	1	0
Meadows Mrs. A. H....	0	10	0
Mennell E.	0	10	0
Miller O. T.	0	5	0
Millard Miss I. M. ...	0	5	0
Moxey J. E.	1	0	0
Nash W.	1	0	0
National Trust (The)	10	0	0
Newman Miss F. B. ...	0	5	0
Oliver Prof. F. W., F.R.S.	1	1	0
Pain P.	1	1	0
Patteson Mrs. F. E. ...	1	1	0
Pearson S. V., M.D. ...	1	10	0
Pelham Rev. Canon S. (the late)	1	1	0
Penrose F., M.D. ...	1	1	0
Plowright Dr. C. T.	2	2	0
Pond H. J.	1	1	0
Preston Sir Edw. Bart., D.S.O.	1	1	0
Purdy T. W. ...	1	1	0
Pym Mrs.	0	5	0
Ransome Mrs. ...	1	1	0
Reeves Hugh ...	1	1	0
Reith Miss E. M. ...	10	0	0
Richmond H. W., F.R.S.	2	2	0
Carried forward	186	7	6

	£	s.	d.
Brought forward	186	7	6
Riley W.	1	1	0
Ringrose Bernard ...	1	1	0
Riviere B. B., F.R.C.S.	2	2	0
Robertson W. K. ...	0	10	6
Rogers Rev. H. ...	1	0	0
Routledge V. ...	0	10	0
Sale of "The Microcosm," per G. Spalding	0	15	0
Sale of Report for 1925	0	5	0
Sargent Cyril G. ...	1	1	0
Savin A. C.	0	5	0
Scolt Head Collecting Box	3	18	0
Sewell P. E.	2	2	0
Sheldon W. G. ...	1	1	0
Simpson F. T. ...	2	2	0
Smith Col. H. F. ...	1	1	0
Soc. for the Promotion of Nature Reserves	2	2	0
Spalding G.	0	10	0
Steward Rev. Canon	1	1	0
Stimpson E.	0	10	0
Stirling A. C.... ...	0	10	6
Strachan C. E. ...	1	1	0
Sumpter Dr. B. G. ...	2	2	0
Tait C. (Oporto) ...	1	0	0
Taylor Dr. Mark ...	1	0	0
Temple Lynes C. T. (Transfer from the old Blakeney W.B.P. Soc.)	1	15	0
Thouless H. J. ...	0	10	0
Upcher H. E. S. ...	1	0	0
Upcher Miss L. ...	2	2	0
Vincent T.	0	2	6
Walter C. H. ...	1	1	0
Walter J. H. F. ...	1	1	0
Wells C. H.	1	1	0
Willett W. L.... ...	0	5	0
Wilson Mrs.	1	1	0
Winch Major S. B. ...	2	2	0
Wright B. D. Z. ...	0	10	0
Wright T. J.	0	10	6
Wyllys H.	0	10	0
Wyllys W. E. ...	0	10	0
Total ...	£228	19	6

NORFOLK WILD BIRDS PROTECTION FUND

Year ending December 31st, 1925

Receipts	£	s.	d.
Balance from 1924	14	8	7
Subscriptions	184	0	6
Special Donations	42	9	0
Collecting Boxes, Scolt Head and Blakeney Point	9	1	1
	£249	19	2

Expenditure	£	s.	d.
Notice Board—Horsey	1	15	0
Watchers—Breydon	35	8	4
Scolt Head	64	6	9
Blakeney	32	0	0
Wolferton	10	0	0
Scolt Head—Tree Planting and Fencing	20	2	6
Scolt Head—Sundry Expenses ...	3	11	6
Printing Report	10	0	0
Receipt Books and Printing ...	1	6	0
Cheque Book	0	4	0
Tern Enquiry Expenses	11	17	6
Balance	59	7	7
	£249	19	2

VII

THE BITTERN AT ITS NEST

By Humphrey Boardman

While excellent photographs of the nest and young of the Bittern have been taken by Miss Turner, no one in this country has hitherto obtained pictures of the old bird at the nest. Jim Vincent of Hickling suggested that we might together attempt to photograph a Bittern nesting, and any success achieved is largely due to his knowledge of bird life, and to the help and advice he gave in the erection of the hide and upon each visit to the nest. The camera used was a Goerz Anschütz with a Dagmar 4.5 lens and focal plane shutter.

On the afternoon of April 20th, 1926, after searching a large area without success, a Bittern flew up from the middle of a marsh, and there we found her nest amongst "gladden" and a few reeds. She flew off again in the evening when we went to erect the hide, and also on the following morning when we visited the nest to make sure she had not forsaken it, but we never again saw her leave it. Whenever the nest was visited the eggs were found to be warm, the Bittern having apparently walked quietly off and disappeared into the reeds.

The hide was erected in the evening of April 20th, four yards from the nest. Four strong stakes were driven in

fastened together with ties, and round this framework were placed about thirty sheaves of reed, which had already been tied up in readiness for thatching. The sheaves were kept in place by thick string round the outside, and the walls were lined inside with hessian to ensure that the old bird could see no light or movement inside. The hide, when complete, was rectangular in shape, about four feet by three feet, and four and a half feet high.

The Bittern has the reputation of being one of the most elusive of birds, and to a large extent this is no doubt true. One may live near the haunts of Bitterns, and even grow tired of their booming, and yet never see them. This Bittern lived up to its reputation of timidity at first, but it grew manifestly more tame as the days proceeded. Three days after the nest was discovered she allowed Jim Vincent to stand outside the hide and watch her on the nest. I sometimes saw her close to the hide if I peeped out of the top, when she would lift her head and beak above the rushes for a few seconds, listen intently, and then disappear from view, to be seen no more until some strange noise aroused her curiosity once more. The smallest of splashes in the water always awakened her interest, although she ignored any gentle coughs or tapping on the framework of the hide.

When the Bittern came to the nest she nearly always approached it from the same direction—from the east side. Only once was she seen on the wing from the hide. She then lit about fifteen yards away and was hardly visible again until she arrived at the nest five minutes later.

The first photographs of the old bird were taken between 12.30 and 1.30 on April 26th. After I had entered the hide three-quarters of an hour elapsed before the Bittern returned. No suspicion of a sound heralded her approach; she just seemed to glide through the reeds, stood erect for a second or two with her beak pointed skywards, and then settled down to brood. Five photographs were taken, but with each release of the shutter she became a little more alarmed and finally left the nest.

The nest when found contained five eggs, but two of these never hatched. Pieces of egg-shell were found one day near the nest, and it is possible that the mother herself

The Bittern at its nest
(*Photographed by H. Boardman*)

BRITISH
MUSEUM
26 JAN 27
NATURAL
HISTORY.

BRITISH
MUSEUM
26 JAN 27
NATURAL
HISTORY.

THE BITTERN FEEDING THE YOUNG ONES

(*Photographed by H. Boardman*)

ejected these two knowing them to be addled. The first chick was hatched on May 2nd, and all were out by May 7th. The actual dates of hatching cannot be given, as the nest was not visited daily, the Bittern being purposely granted days of rest when she was undisturbed. On every third or fourth day the hide was visited for a few seconds merely in order to induce the bird to leave the nest, with the idea that she would gain confidence by finding "all clear" on her return. The second series of photographs were taken on May 2nd, when the nest contained two eggs and one chick.

When all were hatched the mother left the nest for varying lengths of time, sometimes remaining away for three hours and at other times returning in a few minutes. At times she returned to the nest apparently simply to see if all was well, and left noiselessly on finding that the young birds were safe and sound.

We frequently heard her walking about in the reeds near the nest, but it was difficult to see her as her markings harmonised closely with the reeds, and she moved with great stealth. We often knew of her whereabouts by the continuous soft croaking noise which she made, similar to the noise made by the Waterhen. This seemed to be a form of running conversation designed to please the young ones. If they happened to be hungry they would show their excitement by raising themselves up in the nest and gazing intently in the direction from which the sounds came, but usually they were not impatient for their meals.

When the young birds were quite small the mother fed them by leaning over them and putting tiny morsels of food into their beaks. As they grew older they became more aggressive, and as soon as she reached the nest they would stretch up, seize hold of her beak, and grip it tightly (Plate XII.). The mother would then open her beak, making the young one loose its hold sufficiently for her to disgorge food into its mouth. She fed them on frogs, eels and other fish.

An unduly large piece of fish one day caused a tug-of-war between the two eldest of the young birds, but generally they were well behaved and waited for their turns.

When the mother was away for two or three hours on end they apparently suffered from boredom and yawned frequently.

They slept a great deal, and when awake relieved the monotony by running their beaks in and out amongst their feathers and by attending to one another's toilets. The noise of a bird flying overhead always aroused their interest, and they would scan the sky with anxious gaze.

They occasionally left the nest to drink, and had often great difficulty in scrambling back again. They would dig their beaks into the nest to give themselves sufficient purchase to enable them to climb back.

The young left the nest on May 21st, when they were about fourteen to nineteen days old. On arriving at the hide that morning no young ones were to be seen on the nest, but the youngest one returned to it in about ten minutes' time and settled down to sleep all alone. One of the elder ones came four times in two hours to visit it, but the mother did not come, nor did she apparently make any effort to collect her babies. In the afternoon the little birds had apparently left the nest for good. They could be heard croaking to the mother, who replied by making soothing noises by way of encouragement. The youngest bird was barely able to walk and looked quite unfit to leave the security and comfort of its old home; but it had no choice—its mother had settled that the time had come when it must be fed amongst the rushes.

We had no further glimpse of the young birds. The mother was seen on May 22nd walking slowly amongst the reeds about one hundred yards away with head lowered, but the young ones were not seen.

The first photograph of the Bittern on the nest was published in the *Eastern Daily Press* of April 27th and others have appeared in *Country Life* of August 28th and Sept. 11th, 1926. I should like to take this opportunity of making known the fact that soon after the first photograph appeared I was asked for a Bittern's egg. On my refusing to rob the nest I was told by the egg collector that he would secure a clutch next spring by fair means or foul! It is up to all bird lovers who know where there is a Bittern's nest to try and prevent such a crime.

VIII

REPORT OF THE BLAKENEY POINT RESEARCH STATION, 1924-26

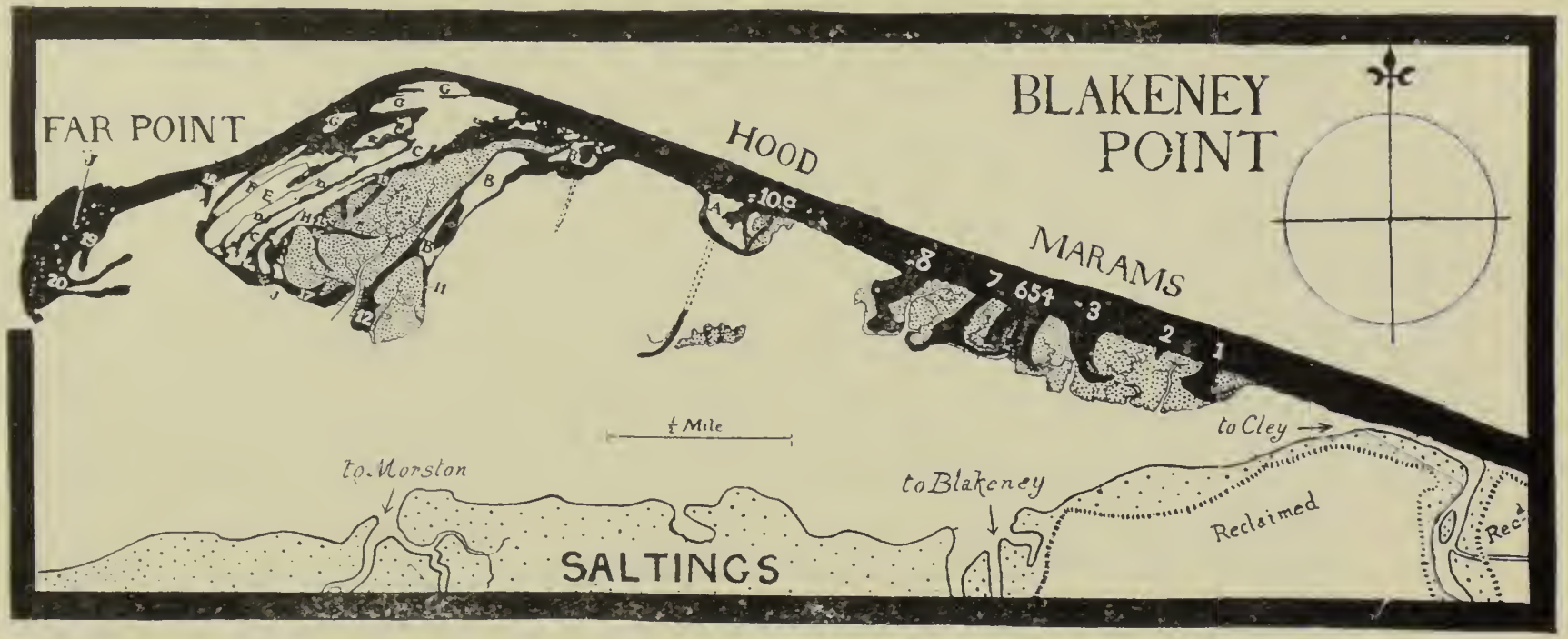
By F. W. Oliver

The present Report deals generally with the period since the issue of the last in 1923. It is divided into sections under which different subjects are considered—some the result of long-continued observations, whilst others have merely a passing interest. In these pages the progress of the Tern Colony is referred to only indirectly, as the matter is fully dealt with by more competent hands in the Reports of the Committee for Wild Bird Protection in Norfolk, which Reports appear regularly in the Transactions of the Norfolk and Norwich Naturalists' Society. In general, it may be said that the breeding birds have done well in the three years under review. The main colony is now concentrated on the Far Point, and includes, in addition to Common and Little Terns, also Sandwich, Arctic, and Roseate Terns as well as numerous Ringed Plovers and a few nests of the Redshank. In 1925 the Sandwich Terns, which had been very numerous in the season of 1924, fell away to small numbers, but in 1926 they returned in full strength. This year,in spite of a set-back in June, the birds did very well indeed. Lack of food and a spell of cold winds caused much destruction of newly hatched birds, but second clutches and a prolonged stay into September, fully compensated for the earlier losses. Our experience in 1925 was somewhat similar—apart from the dwindling of the Sandwich Terns.

In the present report for the first time is given an epitome of the appearance and development of the Far Point, including the establishment of the earlier phases of its vegetation. This area, though not our only breeding ground, is by far the most conspicuous and compact, and is so placed as to be ideal in many respects, especially for the various species of Terns.

The Far Point

Few people who come to Blakeney Point to visit the breeding ground realise how recent is the growth of the area known as the Far Point, where the terns principally nest.



TEXT-FIG. 1. Sketch Map of Blakeney Point. Exposed shingle, black; salt marshes, dotted; sand dunes, white. The lateral shingle beaches are numbered in their order of development, whilst the successive systems of dunes are lettered A to J.

Fifty years ago Blakeney Point possessed an advanced hook reaching out towards Wells, like the present Far Point ; but by 1907 the last vestiges of this had disappeared. The beginning of its destruction is attributed by the older fishermen to the practice of boats from outside removing shingle, and thus inviting a breach by the sea. Once breached the demolition of the rest followed naturally. So far as can be ascertained terns did not breed at all generally, if at all, on the then Far Point, the chief ternery being outside the sand hills to the north of the present laboratory and likewise to the north-west of the Beachway or Pelvetia Marsh. Matters so remained till 1919, when birds first began to colonise the Far Point, which, concurrently, was acquiring the rudiments of a vegetation.

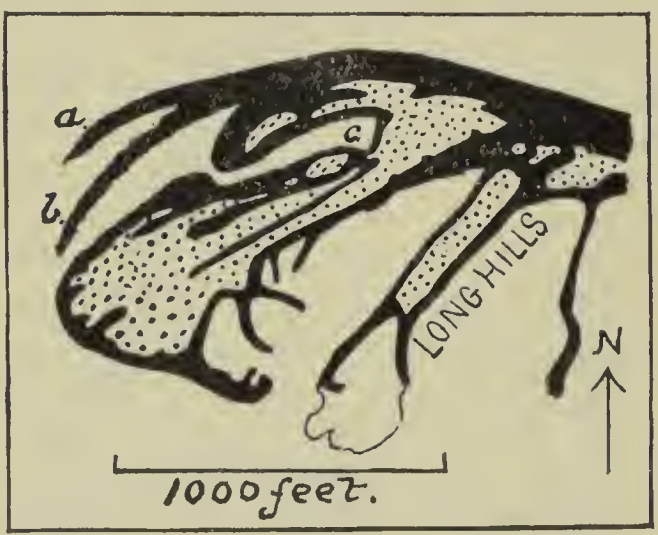
From this starting point the birds came to nest in greater numbers every year. At first Common and Little Terns and Ringed Plovers, then came Arctic and Sandwich Terns, and latterly Roseates (one or two pairs) and Redshanks. In 1925 most, but not quite all, of the Sandwich Terns moved away to Scolt Head (so it is conjectured) where this species was reported in vast numbers, but this year (1926) they were back again. Meanwhile the old breeding ground has been largely though not entirely forsaken. In the Far Point we thus possess an almost unique spot for the terns at a suitable distance from the Headland and standing out into the Channel so as to be washed by the tide on all sides.

On this area of some twenty acres are concentrated for the breeding season five species of Terns, Ringed Plovers, and a few Redshanks—well on to a thousand nests in a favourable year. To all intents and purposes the adoption of the ground by the birds was independent of its colonisation by plants. There was no waiting till vegetation became general so that it might serve as effective cover—from this point of view the plants were negligible till 1922. Directly the ground had been built up above the ordinary tide-marks, birds and grasses appeared together—it was the expression of the fact that a new vacant space had arisen, sufficiently stable for occupation and washed by the all-providing sea—the common source of "whitebait" for the terns, and seed to start a vegetation.

In the following pages it is proposed briefly to outline

the history of the development and colonisation by plants of this remarkable spot—on which matter very full details have been systematically collected; the full account will be given elsewhere, with adequate illustrations of the various features.

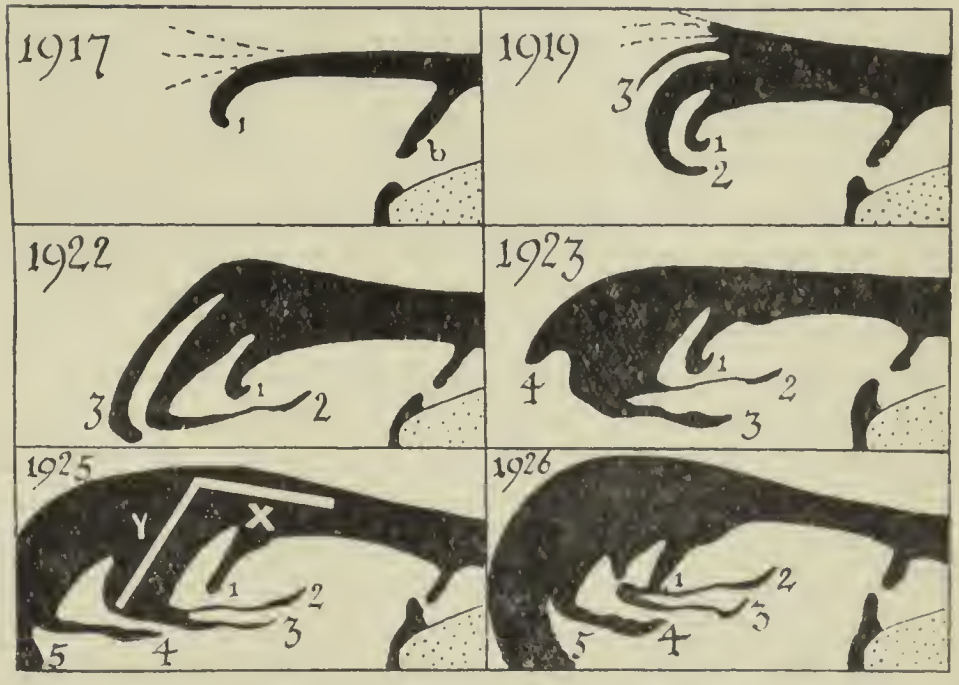
Incidental to these studies has been the explanation afforded of a great many curiosities and anomalies of construction on the older parts of Blakeney Point—matters as to which conjecture only was possible. And no doubt our results when fully described will be applicable to all similar shingle formations. To botanists, the most interesting results that have been obtained and are still accruing (apart from the beginnings of vegetation) are the precise data on the origin of all the different



TEXT-FIG. 2.—Chart of Headland with beginnings of Far Point as in 1913. The outer beach *a* has since advanced nearly half a mile west to form the Far Point. Of the inner beach *b*, only the tip survives owing to the landward travel of *a*. *c* marks Gt. Sandy Low.

sorts of plant habitat which Blakeney Point provides. At the time when the National Trust took over the area there was no sign of this formative outbreak at the apex of the system, and undivided attention could be given to a study of the area as a whole—an excellent preparation for a proper understanding of the developments which subsequently unfolded themselves.

The first indication of the coming extension of ground occurred during the winter of 1912-13, when a broad beach thrust itself out from the Bend to the north of Great Sandy Low. The Sketch Map given in text-fig. 2 is a reprint of one which appeared in the Report for 1914 (p. 5), and represents



TEXT FIG. 3.—Charts of Blakeney Far Point showing development from the year 1917 to 1926. The system of shingle hooks, resting on the level foreshore and rising above ordinary tide level, is drawn in *black*. Each chart is labelled with its year, and the successive hooks are numbered 1—5, in order of appearance. No. 1 is the apex of the beach *a* in text fig. 2, and it has remained in the same position throughout the period. Beaches 2 and 3 (1925, 26) have partially coalesced and have been driven in to unite with 1 (1926), whilst their common base has been breached. *b* is the surviving apex of *b* in text fig. 2. With lapse of time it has shortened through being overlaid by beach *a*, which now has its apex at 1. *Broken lines* represent unconsolidated shingle below high water mark; *dotted area* on right, dunes of Headland. The width of each compartment of the diagram (right to left) is half a mile. The intersecting white lines, x and y, on Chart 1925, mark the axes of the two original vegetated areas, in the order of their appearance.

the condition as charted in July, 1913. The inner arm of this new beach (*b*) stretched almost to the west end of the sand hills, whilst exterior to this a second beach (*a*) had already appeared. At that time this outer beach (*a*) ended in a great expanse of shingle which, lacking definite topographical relief, was covered at high water, and generally was "without form and void." By 1916 the distal end had taken shape and had risen above ordinary tidal limits. It now extended three-quarters of a mile from the point of its insertion upon beach *b*, and its west end subsequently broadened out forming a wide plateau. This plateau has undergone complication by the growth of hooks on its landward side and continues steadily to increase in width by the accretion of shingle brought by storms to its north-west face.

To continue the topography. As the outer beach (*a*) extended west (1914-16), the proximal or connecting part was gradually driven inshore—sometimes as much as 30-ft. in a single storm—with the result that the inner beach *b* was overlaid by it. At the present time (September, 1926) only the tip of this beach survives, still in its original position (Text-fig. 3, 1926).

The whole of the connecting neck which joins the Far Point to the Headland is beating in thus, and this gives the explanation of why this stretch has always been, and still remains, practically bare of vegetation. It is mobility of ground which prevents plants from establishing here.

Distally, shingle is accumulating to broaden the plateau, sometimes by as much as 100 or even 200 feet a year. Some of this shingle works round to the west end, where it forms hooks, numbered in succession 1, 2, 3, 4. The continued growth of a hook depends mainly on how long it is left without being over-lapped by the next. An exterior hook will of course attract to itself such shingle as works round the Far Point. Successive stages in the history of development are represented in the diagrams in text-fig. 3, these being based on plane-table surveys, supplemented by air photographs, and here and there a free hand sketch.

Hook No. 1 is important topographically, as it represents the incurved apex of the whole system (it is the apex of beach *a* is text-fig. 2). It reached its present position in 1916, and,

being marked by a deeply driven stake which survived for a number of years, was easily recognisable amid the increasing complexity. Hook No. 2 became important in 1921, and by October, 1922, had reached a length (pointing east) of 300 ft. No. 3 followed this rapidly, growing parallel to it, and in September, 1925, a storm beat part of it in so that a section of it became super-imposed on part of No. 2.

Hook No. 4 began to face east in the latter part of 1925 and has made appreciable progress. It is to be expected that similar excrescences will continue to arise, provided of course that the tip is fed with fresh shingle. Any marked further advance west is hardly likely, as the further west it extends by so much is the scour at the ebb and flow increased. For every yard of extension means that a large added volume of water has to round the tip of the spit in the same period of time, and the consequent accelerated scour is an obstacle to extension.

In the formation of hooks wave action plays an important part, as anyone can satisfy himself by watching what happens on the Far Point at high water with a fresh breeze from outside. The waves, as they strike the beach obliquely, swing round owing to the friction of the shelving bottom retarding the advance of their shore-ward ends. By this means their direction continually changes and is often entirely reversed by the time they have followed the outside hook round to its cusp. The importance of this factor (differential retardation) in relation to the formation of hooks to a spit in Lake Heron, New Zealand, was pointed out by Speight* in 1910, and now that I have had repeated opportunities of studying the same phenomenon, I can only corroborate what he says.

The above, then, is a brief outline of the development and of the topography of the Far Point. Fed by shingle from the east, the materials accumulate on the site. Growth in length ceases and the extremity broadens, whilst shingle drifting round the end is built into hooks. Given further supplies of shingle, every big tide raises it above ordinary tide marks and adds to the width and security of the existing terrace.

* R. Speight, L. Cockayne, and R. M. Laing, The Mount Arrowsmith District, a Study in Physiography and Plant Ecology. Trans. New Zealand Institute, Vol. XXIII, 1910.

To put the whole matter quite concisely ; *along-shore* movement conveys and assembles the shingle at the spot, whilst *onshore* movement raises it above ordinary tidal limits. This onshore movement is generated by N.W. gales, which raise the tide above the expected heights of the tide table, and the banks of shingle so driven in will remain undisturbed till such time as a similar or even higher tide occurs, driving it further in and strengthening the terrace. These "master-tides" are an essential factor in the construction of ground like the Far Point.

The Vegetation

Wherever shingle comes to rest, and remains at rest above tide marks, plants spring up. These establish from seed left on the drift lines, whilst the drift itself acts both as a mulch and as a fertiliser of the ground. Drift lines tend to reach the higher levels of the beaches, as they are swept up by the highest tides, and once there of course remain. Plants establishing in such positions are apt to appear first in lines following contours—a most characteristic feature this.

Up to the year 1918 the Far Point was not sufficiently consolidated to carry plants. The upper photograph given in Pl. XVI. was taken in September, 1917, from the then apex of the system, at which date not a single plant had established. In 1919, when the topography had become ready, a few insignificant Psammas and Triticums and a Salsola or two, appeared. By 1920 the numbers recorded were as follows :—

Plant.	1920	1922	1924
Triticum junceum ...	15	48	451
Psamma arenaria	10	33	897
Arenaria peploides ...	8	41	572
Salsola Kali	4	—	—
Cakile maritima	a few	—	—

About forty plants in all, distributed along and parallel to the belt marked *x* in text-fig. 3, 1925.

By 1922 the plants of this vegetated area had expanded and multiplied so as to be perfectly visible in air photos taken at

10,000 feet ; the actual numbers present on this belt (*x*) being as in the second column of the table above.

At the same time, a more distant belt, *y* (text-fig. 3, 1925) was just beginning to colonise, especially with Triticum. In 1922 the numbers were, Triticum 38, Psamma 0, Arenaria 8. From this date onwards detailed charts of all plants on the Far Point were made every September after the departure of the Terns—a valuable and unique record, supplemented by numerous photographs repeated annually from the same view points.

Of the staple pioneer plants in the list above, Triticum, Psamma, and *Arenaria peploides* are effective dune builders. Once established, drifting sand collects about them, and as from year to year the unit plants spread by underground runners, the perimeter of each little embryo dune expands. What with this, and the filling of gaps by additional seedlings, the unit dunes, where grouped, blend with each other to form compound structures. This fusion marks an important stage of advancement, for now each of these higher units is much less exposed than was the case before fusion. It has less surface from which sand can be blown away, whilst the various parts of the compound structure give each other mutual shelter.† The collective base of the group can also accommodate a higher dune than could the several bases of the separate units ; so the structure grows apace. With further spread, these dune complexes join with one another in just the same way and still more imposing structures come into being.

Whilst it is easy enough to picture what should happen in an ideal case, without interruption, in practice on exposed situations like the Far Point, there are many vicissitudes and set-backs. A good illustration of this is furnished by the happenings of September 4th and 5th, 1925. On the evenings of these days the Far Point was overrun by extra high spring tides which entirely submerged even its highest points. There was a good deal of wave action and this drove in the crest of the beach of area *x* (text fig. 3) 80-ft., in consequence of which numerous thriving Triticum and Psamma tufts on its seaward side were scoured out, whilst most of the little

† Such a compound dune is shown in the foreground, Pls. XIV and XV.

dunes had their sand heaps washed away and were prostrated on the ground The photographs on Pl. XIII give some idea of the condition before and after. Photograph 1 was taken in August, 1925, photograph 2 on September 10th after the inundation, whilst photograph 3 shows the recovery in August, 1926. All are from the same view point, looking west along the belt *x* of text-fig. 3.

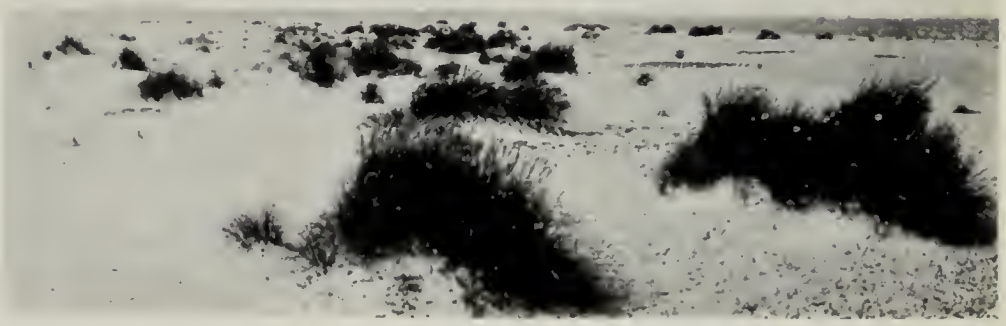
Area *y* suffered less, as the effect here was rather to raise than to lower the ground level.

A noticeable feature of these inundations is the colour differentiation produced between Psamma and Triticum. The former turns yellow, whilst the latter remains green. Psamma is not a halophyte, and its low osmotic pressure is inadequate to withstand sea water. Unless immersion is prolonged, however (several days), the rhizomes are not killed and normal tufts of leaves will arise the following season. Triticum behaves as a true halophyte and is unaffected—a property which gives it particular value in pioneer stages when the ground has not been built up to its full height.

In spite of this set-back, or it may be in consequence of it, the plants thrived wonderfully in 1926. The buffeting and shingling-over here, as ever, greatly stimulated the plants, and at the present moment the vegetation is denser than ever. (Pl. XIII., photograph 3).

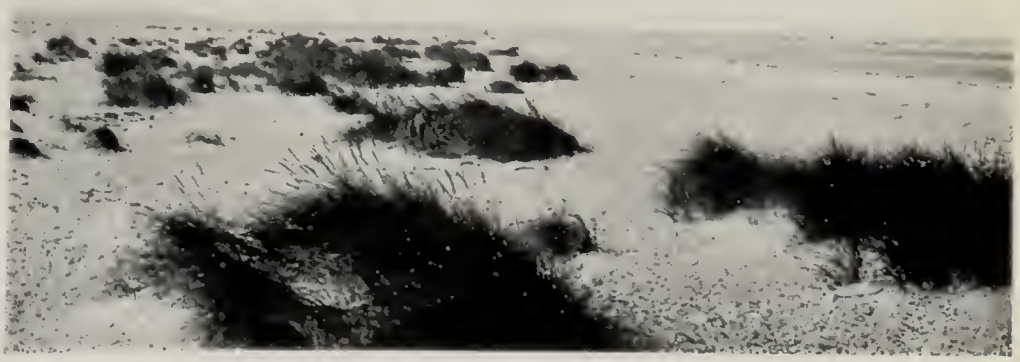
As to the actual ground lost by the advance of the crest at *x*, this has been more than compensated for by a gain of several acres further west.

At the moment these lines are passing through the press the report comes of a further high tide (23rd October, 1926) which completely overran the Far Point, prostrating the vegetation and washing away most of the accumulated sand heaps. These recurrent vicissitudes are inevitable ; and though they temporarily check progress, properly regarded they are merely the sea's way of cultivating the ground. These methods are drastic and undiscriminating, but they lay the foundations of ultimate success. And for this reason. Prostration and injury stimulates enormously vegetative activity below the ground level. There is increased production of runners, whereby the bare ground between existing plants is rapidly filled ; moreover additional seed is scattered, which leads to



1. August, 1925

2. Sept. 12th, 1925. After inundation



3. August, 1926. Recovery

THREE IDENTICAL VIEWS OF VEGETATION ON FAR POINT

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View on Far Point, 1924

The same View on Far Point as it appeared in 1926

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the same result. The tendency of these inundations then is to improve and complete the mat of vegetation; to bring closer together the tufts of plants in the following season, so that the little dunes that will arise will more readily blend into compound aggregates, giving substantial sandhills which will later prevent these incursions. With a proper covering of dunes, a master tide merely nibbles at the fringe, and any removal of sand is automatically replaced by the wind. It is to be expected therefore that the season 1927, will show as great an advance on 1926, as did this on 1925.

Later arrivals on the Far Point include *Obione portulacoides*, *Silene maritima* (1925), *Atriplex littoralis*, and *glabriuscula* (1926), and some quantity of what appears to be a dwarf form of *Glyceria maritima* (1925). *Plantago maritima* was recorded as far back as 1924, and is multiplying.

Enclosed between the hooks and the main beach are tidal flats, which, apart from drifted Algae, remained bare of vegetation till 1925, when a few scattered examples of *Salicornia europæa* appeared. These seeded in place and, as numerous clumps established in 1926, this should mark the beginning of future salt marsh.

The birds were quick to recognise the possibilities of the Far Point, and by 1919 a group of pioneers was nesting on the ground, i.e., at the same time as the first plants had aggregated to about 15 individuals. To all intents and purposes the plant and bird settlements, though concurrent, were quite independent. The birds have no essential need of the vegetable world, though, as the plants make good, birds profit from their shelter, and also use the grass to some extent for the decoration of their nests.

From 1919 the Terns gradually concentrated here, a few Sandwich Terns arriving in 1920, and Arctics and Roseates later on. The Sandwich Terns, which have greatly increased, are more gregarious in their nesting habits than the other species, and are especially prone to "build" on Triticum dunes—often fifty together within a few yards.

The birds do little or no damage to the plants, whilst their droppings and the unconsumed fish left about must represent an appreciable gain of organic matter to the soil.

Not so the rabbits. Though no rabbits reside on the Far

Point, and though during the breeding season occasional trespassers are promptly chased off by the Terns, after the latter have departed the rabbits are not interfered with and their visits are marked by evident nibblings of Triticum, Psamma, Cakile, Polygonum, *Plantago maritima*, and other plants. The aggregate result, if slight, is sufficient to prevent certain colonists which are sparsely represented from flowering.

In fullness of time, no doubt, some rabbit will take one of these little dune complexes seriously and dig out a hole. And so the rabbit plague will spread from the Headland to the Far Point.

Drift of Shingle

That shingle drifts along our beach from east to west and accumulates at the tip is evident to every observer. The prevalent winds on the other hand come from the west, so that the direction of drift is *against* the wind. What then are the particular forces which determine its direction? This problem has latterly engaged the attention of Mr. J. A. Steers, who, with a party from Cambridge, has visited our area as well as Scolt Head on several occasions. I am much indebted to Mr. Steers for the following note on his work here.

"Some casual observations made a few years ago on the direction of the tidal currents along the main beach at Blakeney suggested that the view which ascribed the growth of the beach to their action needed revision. With the object of demonstrating this point some regular observations were made in 1925 and 1926. The method adopted was to watch the drift of floats thrown just outside the breakers. These floats were timed over a measured distance. All these observations showed that close inshore the water was moving *to* the east with a rising tide, and hence *against* the growth of the spit. Further confirmation of this was obtained from the officer in charge of the former Coastguard Station at Morston.

"It appears, then, that tidal currents cannot be responsible for the westward growth of the shingle. This is very important, inasmuch as the shingle, lying high on the beach, is only worked on at high water. (This is more particularly the case toward the western extremity of the Point). It is, perhaps, a little early yet to state

definitely to what cause the westward growth of the beach is due, but it is probably the result of beach drifting westward under the action of waves approaching from a north eastern quarter. Long period observations on this matter are being made by Mr. Chestney at Scolt Head. Here conditions (except for the tidal currents) are similar. At both places the greatest amount of open water is to the north east, and big waves can travel in from this direction. Further, waves from this quarter often break on the beach when the wind is from any other point of the compass. These waves are due to winds acting far out in the North Sea, and they travel onwards long after the impetus originating them has ceased.

"These questions are discussed more fully in a paper on Scolt Head in the current number of the Norfolk and Norwich Transactions. Tables are there given showing how the tidal observations were made at Scolt Head, where the same method was used as at Blakeney."

Dune Horticulture

In a very small way cultivations of trees, shrubs, and other plants have been in progress for the last twelve years in one or two experimental areas near the Laboratory. The general idea was to discover what plants would settle into unmodified dune sand without special attention or protection. We began years ago with young pines and other trees (birch, elm, sycamore, elder, Diervilla, Buddleia, poplars, willows). These were mostly plants about 4-feet high, and were put into the ground during the war at a time when wire netting was not procurable. Without exception this first batch was destroyed by rabbits. The next attempt was with younger stuff, protected by wire netting. These, after various vicissitudes, such as drought and cold winds, mostly met a lingering death. Quite young plants in their second year were then tried, and these have generally proved successful, especially different species of pine, including *P. austriaca, Laricio, sylvestris* and *Cembra*. Of other trees, *Populus alba* and *P. balsamea*, with the willow *Salix daphnoides*, are the best.

Four years ago a batch of seedling *Pinus austriaca*, straight from the seed pan were put in, and these have done very well indeed. There seems no doubt at all for woody plants that the younger they are put out the more likely are they to establish.

With Gorse we get the same result. Plants at 2-feet died without exception, in all exposures. Seedlings planted in March flowered the year following, and in the third year were 3-feet high and covered with bloom.

Best of all have been the Buddleias, *B. globosa* and *variabilis*. These throve from the first and the latter species flowers generously throughout July and August. At the end of winter the latter is pruned hard back.

Tamarisks are disappointing, and do well only where they are watered or receive the overflow from a water tank. Hippophæ has failed to establish with us and every effort to grow a lavender hedge has failed. Tree lupins on the other hand do very well indeed, requiring only some protection from the wind. Oddly enough, a plant of *Aloe filamentosa* has survived, though unprotected. It increases in size every year and is the only plant on the Point immune from attack of rabbits.

Bulbs generally do extremely well, especially Hyacinths, Tulips and *Galtonia candicans*, though they require protection from wind.

A few annuals, raised *in situ* from seed, have been tried, and the following are eminently successful : Calendula, Phacelia, Annual Blue Lupin, Mignonette. It is rather astonishing to have to report favourably on Phacelia, seeing how uncertain it is in garden soil.

In general, it may be stated that the natural dune sand has been unaltered except that the ground is dug over and the larger plants of Psamma removed. In the case of the Tree Lupins, a little drift was forked in, whilst the bed where the annuals grow received a dressing of mud from the salt marsh, which, after weathering three months, was dug in.

The information here given is necessarily meagre, but as the results are properly authenticated they seem to be just worth placing on record.

As regards fencing against rabbits, our experience is that half-inch mesh is necessary for absolute immunity. Young rabbits find their way through one inch netting quite often enough to be mischievous. When I was ordering a roll of half-inch netting at an ironmonger's, a man in the shop told me he had had experience of rabbits in Australia, and that 1½ or two inch netting was considered adequate out there. In

view of our bitter experience, it is evident that the Blakeney rabbits either show their vicious tendencies at a much earlier age than their cousins in Australia, or that the latter are born appreciably larger. Our rabbits are a domesticated strain run wild. I once met a woman who boasted that it was her grandfather who had let loose the original pair on the Point ! But the subject is too painful to pursue in print.

In the way of dune cultivation, i.e., planting of marram grass to hold the shifting sand and build up sand dunes, a highly specialised technique has been developed in France, Germany, and Holland. We ourselves have done little along these lines, letting the dunes run wild in the natural way. Exceptions to this policy of inactivity include the unprotected south west end of the Point and certain troublesome " blow-outs."

Formerly very high tides were apt to find entrance to the dune area by the gaps left in the natural construction, thus flooding many of the Lows and contaminating the well of fresh water near the Life Boat House. After such an inundation it would take three months or more for the well to recover. This trouble was ended by placing bundles of gorse, cut on the golf course and boated down, along the lines it was desired to close. Sand was quickly blown up, burying these bundles and forming a defensive bank, excluding the tides. Marram gradually fixes these banks ; but they require watching, as Marram grass is prone to grow more rapidly on certain sections of the bank than others, with the result that certain points on the crest project higher than the rest. This leads to undercutting of these points by the wind, and by the blowing away of sand the bank may be cut down to base level once more. For additional safety we are about to plant seedling gorse plants on this bank.

" Blow-outs " arise where the surface covering of a dune becomes broken, as by rabbits or tread of human feet. Where such places catch the wind much sand is removed and an extensive, bare, concave area may result. Many such blow-outs are traceable to the period of the war from soldiers on guard duty always following the same track lines, and are now developing into large, bare, travelling areas. To heal them over it is necessary (1) to place obstructions which will prevent the wind

from forming eddies, and (2) to plant Marram grass on the protected surface. Several of these are being taken in hand.

Dune Soils

A sequel to the investigations on Blakeney soils of which an account was published in July, 1922* has been the study of dune areas in other parts of Britain. The results are confirmatory of the main conclusions deduced from the study of the Blakeney system, namely, that the initial stages exhibit a very low organic content, an alkaline reaction, and a comparatively high proportion of carbonates, whereas, with the passage of time, the calcium carbonate becomes leached out and, as the succession proceeds, the organic content increases and an appreciably acid condition is realised.

The extensive dune system at Southport has furnished important data respecting the time factor †, from which it appears that leaching there takes place at a much more rapid rate than at Blakeney, probably due to the higher rainfall. In both areas the calcium carbonate is reduced to a minimum in about three hundred years, but an acid condition is realised much sooner (about one hundred years at Blakeney and two hundred years at Southport‡). The rate of accumulation of humus varies widely, but shews a marked tendency towards rapid acceleration at about that phase of development at which the reaction becomes acid, and may be due to the direct effect of the Hydrogen-ion concentration on the organisms concerned in the decomposition of organic material.

Very striking variations have been observed with respect to the calcium carbonate content of early dune phases, and the following figures may be quoted as shewing the relatively low proportion of comminuted shell fragments in the embryo dunes at Blakeney as compared with those of other systems.

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* The soils of Blakeney Point; A study of soil reaction and succession in relation to the plant covering, by E. J. Salisbury, *Annals of Botany*, Vol. XXXVI.

† Note on Edaphic Succession in Some Dune Soils with Special Reference to the Time Factor, by E. J. Salisbury, *Journal of Ecology*, Vol. XIII., 1925.

‡ Owing to the much higher initial carbonate content at Southport as compared with Blakeney.

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Far Point, taken from near The Apex looking E., Sept., 1917, before the establishment of vegetation. The picture is comparable to those of Plates XIV and XV.

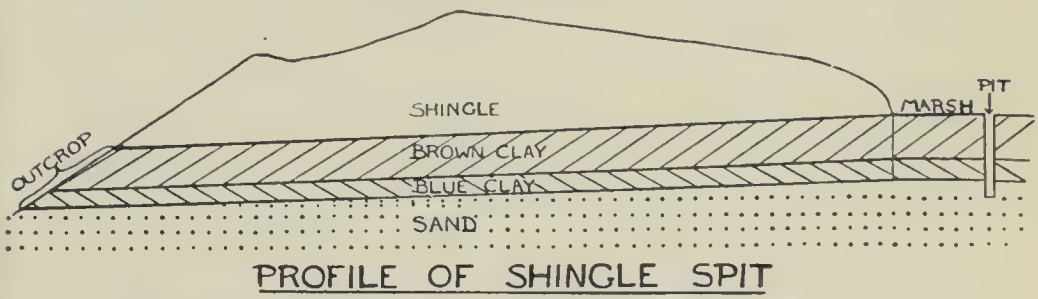
General view of beach at Marams showing outcrop of marsh soil (with figure standing at its upper edge) looking west. The open sea on the right. The marshes are over the crest on the left. Sept., 1923.

Locality.	Percentage of Calcium Carbonate.
Blakeney (Norfolk)	0.28%—0.61%
Borth-y-Gest (N. Wales)	1.0—1.8%
Southport (Lancashire)	5.6%—6.7%
Whitford Burrows (S. Wales) ...	11.8—13.5%
Bundoran (W. Ireland)	9.0%—16.9%

In the light of these data it is scarcely surprising that calcicole species are often found as a prominent feature of the early phases of dune vegetation, and the results of the study of the soil changes at Blakeney and other dune systems, together with investigations on woodland soils, furnish strong support to the view that in our climatic conditions, at least, the phases of succession are associated with a definite sequence of changes in the soil ; so that in general *the phase of vegetation associated with the higher organic content, the higher acidity, and the lower content of carbonates will be the older member of the succession series.*

Fossil Plants

As is well known, the main beach is advancing steadily over the marshes in consequence of shingle being thrown over



PROFILE OF SHINGLE SPIT

Text-Fig. 4.—Profile of beach at the Marams ; vertical factor x 5. The outcrop appears on the left, and on the right a portion of the marsh with pit dug. The vertical depth of the brown and blue clay, respectively, was 3.4 and 1.8 feet at the outcrop, and 3.5 and 1.9 feet in the marsh. The drop in level from marsh to outcrop was 2.5 feet. The width of the overlying shingle was 274 feet.

the crest by extra high tides. This shingle is deposited on the landward side in the form of talus fans which creep ever onwards. In this connection some interesting new data have come to hand through the efforts of Mr. R. E. Hunter and Miss W. Mottram.

In September, 1923, the sea for once in a way had cleared the shingle from the seaward slope at the Cley end of the Marams, exposing the outcrop of marsh mud (Pl. XVI, lower photograph). Text-fig. 4 shows the relations of beach, outcrop

and marsh ; the correlation of the strata is good, and justifies the inference that they are continuous from one side to the other. The outward dip from marsh to outcrop is probably due in part to the pressure of the overlying shingle, and in part to the fact that, once buried under the advancing shingle, accretion ceases, whilst the normal marsh surface goes on rising (the position of this outcrop is between the figures 1 and 2 on the Main Beach. See Text-fig. 1).

A point of great interest was the occurrence in the upper two feet of the outcrop of fossil remains of plants. These consisted for the most part of the rhizomes and roots of *Statice Limonium* in a blackened condition, but showing very perfect preservation without any trace of petrifaction. The clay had acted as a very effective preservative. The specimens, though rather brittle, lent themselves to sectioning with a razor, and microtome series were prepared. A few stems of Obione were also found, and a thin bed of seeds, identified as *Atriplex* sp.

The age of these fossils is estimated at two hundred years, based on direct observations of the advance of the lee-fringe of the beach checked by landward advance of the crest in relation to the fixed line of telephone poles. Allowance has also to be made for the depth in the mud at which these fossils occur, i.e., a period of silting antecedent to being covered by the advancing beach. It is of course assumed that the data of beach travel since 1910 are applicable to the preceding period.

An investigation followed as to the conditions under which these fossils grew that they should have survived ; for in ordinary salt marsh soils here carrying a turfy covering, the plant remains disintegrate.

A study of bare areas on the marsh (" pans ") shows that two types of pan occur, hard and soft. The latter were found to preserve their buried vegetations, and it seems likely that the fossiliferous part of the outcrop is derived from a former extensive soft pan. Further studies are likely to accrue.

Since these lines were written the outcrop has once more been exposed. This occurred in the middle of September, 1926, when the face of the beach, due to the temporary withdrawal of shingle, was smoother than seen for many years.

The part exposed was much more extensive than in 1923, and included a section on the Cley side of the previous exposure. Mr. Hunter took advantage of the opportunity to dig fresh trenches and collect ample material, but this chance was a fleeting one, as the very next day it blew hard and the shingle closed over the outcrop making further investigations impossible.

Litter

In spite of all that has been written on this subject, the lunch-paper man triumphantly keeps his end up. The problem is not unknown on Blakeney Point, though its severity is mitigated. Litter reaches the Point in two ways. There is the sea-borne drift, with its quota of bottles, treacle tins, and the like. Though we would not choose to have these accessories, we have learnt to tolerate them on account of the natural humus and drifted seeds which accompany them. These fertilise and colonise the shingle, and were they denied us it would be necessary to import hundreds of boat loads of manure and to collect and scatter seed. Where shingle beaches are isolated from the tide they tend to become sterile and lose their cohesion. The Far Point could not exist as an organised entity were the tide by some means prevented from casting its drift ashore.

The other form in which litter comes is as sandwich papers and the numerous cardboard containers of chocolates, photographic films, cigarettes, etc., which some visitors leave behind. The difficulty is to know how best to lead them gently to change their ways.

It is foreign to the spirit of the Point that there should be a circulating patrol to remind picnic parties of their duty in this matter. Nobody cares to be warned in advance of a breach of good manners not yet committed ; it merely annoys —or may even provoke resentment. Most offenders probably scrape their boots on entering a private house and leave no rubbish in the garden, yet when they come to a place like Blakeney Point, which is far more wonderful than anything made with hands, they treat it as a dumping ground and contribute to the destruction of its amenities. Sometimes a pleasure party can be spotted at once as likely to leave reams

of crumpled and greasy paper behind. In such cases the nuisance may be averted by providing them with a capacious basket, and at the same time remarking that they probably have a lot of paper that they won't require again ; that the Point is short of fuel for the copper and bakehouse, and that it would be an act of charity to bring it in. Later, the junior member of the party usually delivers the basket at the Pilot House, getting an apple or slab of chocolate as his reward.

Mere notices are of little use. Doggrel rhymes, with a laugh in them, sometimes touch the spot, but they have to be varied, and the poet is not always available. Better still would be the small picture poster consisting of a series of drawings, such as Bateman or Fougasse of Punch might do, portraying the fate of " The man who left his lunch papers on Blakeney Point." Practitioners in this field tell me that the method makes a very wide appeal, but competent and willing artists are rare.

A naval officer serving in a battleship in the Grand Fleet had to take parties of seamen ashore for route marches—I think it was at Invergordon. On the first occasion, when the men fell in after a picnic lunch, acres of ground were seen to be strewn with sandwich papers. My informant at once put the men into open order and marched them to and fro, at the double, across the area till not a paper remained. On subsequent route marches there was no more trouble, the lunch papers being stowed automatically in jumper or cap till a suitable opportunity presented itself for disposal.

Many visitors have a good intention but use improper means to carry it out. If buried in the surface layers of the sand, litter inevitably comes to light again when the wind blows the sand away ; whilst to burn it is apt to set the Marram grass on fire. If litter must be left on the ground, the most effective method is to poke it far down the mouth of a rabbit hole. If this is properly done the rabbits accept the position, and often make a fresh entrance not far from the one blocked. The best way of all, however, is to make a parcel of all the litter and deposit it in the large basket under the balcony of the Point House. It then becomes potential fuel.

LOSSES BY DEATH

By the death of MR. A. W. COZENS-HARDY, of Cley Hall, the Blakeney Point Committee loses its original Chairman. He joined us at the outset in 1913, when the National Trust took over. From his position in the neighbourhood, and the great interest he always took in the work of the Trust, Mr. Cozens-Hardy rendered essential service, especially in the earlier years, and his loss will be much deplored. He is succeeded in the Chairmanship by Mr. Robert Gurney.

MR. W. G. CLARKE, though he actually joined the Committee only last year, had always been a friend of this place, and a visit rarely passed without forming the subject of one of those delightful and well-informed articles which were wont to appear in the *Eastern Daily Press*. By his untimely death we mourn a gifted naturalist, antiquarian, and local historian, whose attainments were recognised far beyond the county from which his inspiration was largely drawn.

SIR EDWARD BUSK was an original member of the Committee, having been nominated by the Fishmongers Company. Though not a frequent attender, he gave valuable service in consultation, and although deeply immersed in the affairs of the University of London, etc., kept in close touch with our proceedings.

MR. C. J. TEMPLE-LYNES died on November 3rd, 1926, a few days after Sir Edward Busk. He was a remarkable figure in the locality, in which he had lived continuously throughout a very long life. He was prominent in all local affairs, and his death makes a gap that cannot be filled. From the first he was a constant attender of our Committee meetings, where his intimate knowledge of the circumstances and history of the district, including Blakeney Point, made him quite indispensable. It may be recalled that after the erection of the large Lifeboat House in 1898 he purchased the Old Lifeboat House, and for a few years let it for the convenience of beach parties—a function now fulfilled by the larger house since its purchase from the R.N.L.I. by the National Trust in 1922.

MISS WINIFRED SMITH, who occupied the position of Tutor to Women Students at University College, had been from the beginning a constant member of parties at the Old

Lifeboat House. No one loved the Point more than she did, and none will be more missed. About three years ago I remember her saying, "My Blakeney days are done"—and it was so. She died on Christmas Eve, 1925.

MR. LIONEL COLE had made several visits in recent years, and did good work as a plant surveyor and in other ways. At the time of his death in 1924 he was Lecturer in Botany in the University of Sheffield, where he was held in high regard.

GIFTS

The following donations of money, made since the issue of the last Report in 1923, are gratefully acknowledged. They have been credited to the Fund for the upkeep of the Laboratory, purchase of apparatus, and the like :—

Miss V. L. Anderson, £1 ; Dr. E. P. Farrow, £1 ; Dr. J. S. Gayner, £8 2s. 0d. ; the late Dr. H. B. Guppy, £1 ; Dr. E. J. Salisbury, £2 2s. 0d. ; Mr. A. G. Tansley, £5 ; Mrs. Tansley, £5.

Gifts of books to the O.L.B.H. Library have been received from Dr. Winifred Brenchley, Dr. Farrow, Dr. S. H. Long, and the late Mr. W. G. Clarke. Among those presented by Dr. Long should be mentioned a beautifully bound copy of Witherby's new book on British Birds, in which a set of coloured plates, by various hands, has been bound in. Dr. Long has also presented a bookcase worthy to contain these and other contributions. The idea behind this little library is that it should contain just those works of reference, inspiration, consolation and relaxation as are appropriate to the special conditions of the Point, and it is largely through our benefactors applying their minds to this point of view that such good progress is being made along this road.

The BLAKENEY POINT COMMITTEE is constituted as follows :—Mr. Robert Gurney (Chairman), Mr. J. W. Allen, Mr. T. W. Bourne, Mr. J. W. Castle, Mr. Walter Derham, Mr. G. Claridge Druce, Mr. W. A. Forsyth, Mr. Quintin E. Gurney, Capt. L. W. Lloyd, Dr. Sydney H. Long, Professor F. W. Oliver (Hon. Sec.), Mr. Sam Peel, Dr. E. J. Salisbury, and Miss M. A. Sewell.

IX

SCOLT HEAD ISLAND

By J. A. Steers and O. D. Kendall

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Preface

A short note by one of the authors of this paper appeared in Vol. XII., Part I. of the Transactions of the Norfolk and Norwich Naturalists' Society last year. Attention was there called to various problems which confronted the geographer in the study of Scolt Head Island. The following paper is an attempt to elucidate some of these problems. One of the fundamentals in this study was a record, in the form of a map, of the recent changes which have taken place in the shape of the island. Also more careful mapping of the shingle spits running back into the marshes was much needed. This mapping has been undertaken by Mr. O. D. Kendall, who hopes to make a re-survey of the western extremity of the island each year. The careful mapping of new additions in this way is particularly interesting and important. An account of that mapping forms Part II. of this paper.*

Several other problems still need attention, but these must be left until later. Since last year the Committee of the National Trust have appointed Mr. Chestney watcher on the island, and among his other duties, he is now making careful observations on waves and winds, which, it is hoped, will lead to interesting results in the future.

* In so far as authorship is concerned, Parts I. and II. are quite separate; there are obvious conveniences in combining them under one paper.

Part I

The Physiographical Evolution of Scolt Head Island

By J. A. Steers

1. Introduction

This paper deals primarily with Scolt Head Island. However, it is worth while to enquire how the evolution of the island itself is related to the physiography of the Norfolk coast in general. Broadly speaking, the Norfolk coast may be divided into two parts; (1) the low marshland coast extending from Holme to Weybourne, with which may be included the eastern shore of the Wash; and (2) the stretch of coast from Weybourne to Yarmouth, a coastline where soft cliffs and low sandy foreshores alternate in fairly regular sequence. Scolt Head Island belongs to the former division.

The last movement of a widespread nature to affect East Anglia was one of submergence, probably in Neolithic times. We can trace the results of this movement in the drowned river valleys and submerged forests†. After this movement was completed the north Norfolk shore was very different from what it is now. At the present time it is easy to trace a ridge of higher ground, just inside the marshes, from near Holme to Weybourne. This ridge is the old sea cliff. The present foreshore is now often two or three miles seaward of this. This is due in large part to the enormous amounts of sand which have accumulated off the west part of the north Norfolk shore. These accumulations must be connected with the prevailing drift down the east coast of England impinging on the projection of Norfolk. These sands have caused a great area of very shallow water. Later long-shore action has led to the growth of spits and bars which have gradually grown outwards from the old shoreline. This is very well seen in the case of Blakeney, where the great shingle spit leaves the cliffs at Weybourne and runs westwards for nearly nine miles. Together with the development of these spits and bars, there has been a corresponding growth of marshlands within—and these marshlands owe their origin to the protecting shingle spits.

† The evidence derived from the Submerged Forests is not very reliable.

If a generalized transverse section were to be made anywhere along this stretch of shore, the following sequence would be noted :—(1) The interior highland terminating seawards in a steeper slope which represents the former sea-cliff ; (2) A flat area of marshland, in part reclaimed by man, in part normal saltmarsh ; and (3) A sand and shingle foreshore, often of the nature of a true sand and shingle spit.

Along-shore action is, for the most part, engaged in lengthening such spits. But, together with this movement, there is a shoreward movement as well. The waves playing on the beaches slowly roll them landwards, much in the same way as a sand dune is blown forward by the wind. This landward motion is slow, but steady. Often an exposure of marsh mud, shewing roots of marsh plants, appears on the foreshore, testifying to the existence of this movement. At a still later stage wind action playing over the vast sand flats, which are exposed at low water, has caused the piling up of dunes along great stretches of the Norfolk coast. These dune areas are some of the finest in England and are best seen at Burnham Overy and Scolt Head.

Minor changes in the marsh creeks and sandhills are constantly taking place. But the more important changes, such as the growth of the sand and shingle spits, are the most striking. Evidence of their very rapid growth can be obtained from a study of the several editions of the Ordnance Survey Maps ; earlier maps of this particular shore are scarce.

2. General Description of Scolt Head Island

Scolt Head Island is a marine formation very similar in its general characteristics to Blakeney Point. It consists essentially of a main beach with several excellent and long recurved ridges. Each of these ridges in turn formed successive ends of the island. Again, as at Blakeney, the spacing of these ridges is by no means regular. At the eastern end of the island, as can be seen on the map, there are fewer ridges than at the western end. On the other hand, near House Hill and Privet Hill there are several close together. This spacing depends on at least two factors. (1) The main long-shore drift, which is here westwards, (2) The forces tending to recurve the main beach, thus producing the long recurved ends. There is no

reason to expect these forces to act with even approximate uniformity ; sometimes one is in the ascendant, sometimes the other. *

With the general westward growth, however, there has been another movement—the whole main beach has been rolled steadily landward (cf. Carey and Oliver, "Tidal Lands," Ch. XII.). The extent of this motion can be gauged in part by an observation made by Mr. Chestney, the present watcher. He told the writer that he observed *Suaeda* roots on the foreshore and about thirty yards from the dunes near the western end of Norton Hills† (i.e. the eastern dune belt on the island). In all probability, then, several minor recurved ends, which may once have existed, have now been obliterated by the landward travel of the main beach. This would account, in part, for the present very irregular spacing of these ridges. (See below.)

Diagrammatically the growth of the spit may be shewn as in the following figure (fig. 1).

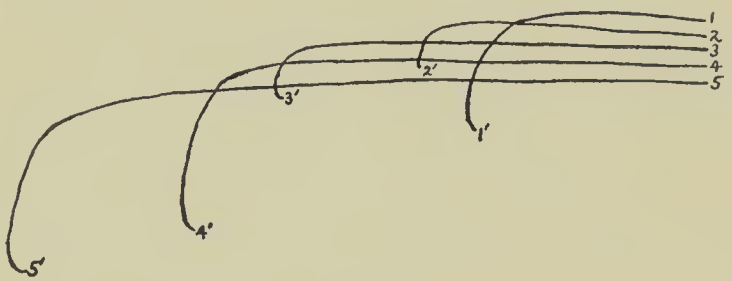

FIG. 1

Suppose (1) to represent the beach at a former time ; and (1′) to be the recurved tapering extremity of this beach. Gradually, as a result of wave action, the main beach is lengthened and pushed back to position (2), with a recurved end (2′). Conditions were then not favourable for the formation of such a long recurved end as (1′). By repetitions of the process, stages (3), (4), and (5)—which may be supposed to represent the present form—were passed through. It can be seen that the

* *Vide* D. W. Johnson. "Shore Processes and Shoreline Development," p. 290 (1919).

† In order to distinguish these hills (which are sometimes called Overy Hills) from those east of Burnham Harbour, to which the name Overy Hills strictly applies, they have been named Norton Hills on the map (plate 18).

main beach (5) possesses (5′), (4′), (3′) and (1′) as recurved ends. These vary in length. On the other hand the recurved end (2′) is completely lost and so a big gap appears between (1′) and (3′). Further, as these longer recurved ends are necessarily unstable, they, too, show a tendency to secondary recurving, as shewn in the figure.

In nature this recurving is even more complicated, and several of the longer lateral ridges shew very complex twists. (*Vide* the ridges near House Hill on the map.)

Later, both the main ridge and the secondary laterals received a covering of dunes, and it may be taken as a safe index that a dune ridge always stands on a shingle and sand ridge, even if the latter cannot now be seen. The supplies of sand for the building of these dunes were close at hand. At low tide a very wide expanse of sandy foreshore is exposed, and strong winds blowing over it soon dry it and carry much sand inland. The dunes on the secondary ridges were presumably formed in the same way.* If a visit is made to the western end of the island to-day, vast sand flats extending to the west are seen at low water. When the successive laterals were formed there is every reason to suppose that conditions were very similar. Consequently, when a new lateral had formed, a space of quiet water was left between it and the former ridge. Gradually, as at the western end of the island to-day, this received deposits of mud, etc. At the same time marsh vegetation began to grow on it. The final result was a gradual raising of the level and the formation of the marshes we see to-day between the several laterals.

Instructive comparisons may be made between Scolt Head Island, Blakeney Point and Orford Ness—all three East Anglian shingle and sand spits. At Orford practically no sand exists and there is comparatively deep water off-shore. At Blakeney the proportion of sand to shingle has increased considerably, especially toward the western end of the Point. At Scolt Head Island the proportion is still greater. Here, too, is the shallowest off-shore bottom. These two factors, the smaller percentage of shingle and the shallow off-shore zone, have probably had a good deal of influence on the spacing

* See page 237, paragraph 2.

and formation of the recurved ends, although it is difficult to say exactly what this influence was.

At both Blakeney Point and Scolt Head Island the separation between shingle and sand is very marked, especially after a period of fairly calm weather. After strong on-shore winds the beaches are "combed down" and the line of separation is less distinct. In both cases the main beaches have grown to the west. These main beaches are, for the most part, shingle beaches, though there is much sand at Scolt Head. As the tide has a considerable vertical range at both places, it is mainly at high water that tide and waves can work on the shingle. Certainly at Scolt Head the shingle is not touched at low water. It follows from this that shingle and sand are acted upon from different directions—with the ebb and flow of the tide—at high and low water. The effects at high water are discussed at length in a later part of this paper. It is not proposed to discuss here exactly what happens at low water. But it may be interesting to call attention to the fact that whereas the growth of the main beaches has pushed both Blakeney and Brancaster Harbours westwards, the sand, below the shingle, often causes the mouths, as seen at low water, of both harbours to recurve eastwards again.*

Professor Oliver† has suggested that Burnham Harbour is a break-through and not a normal outlet. Such a breach might very easily have been caused at a weak point in the main beach when a great volume of water was driven into Brancaster Harbour at a high tide by north-west winds. The evidence, now existing, for this break-through is meagre, but the general appearance of the harbour speaks very strongly in its favour. Just on the Scolt Head side of the harbour is a large marsh characterised by the dominance of *Aster*. This plant is indicative of a young stage of marsh development—pointing to the recent formation of Burnham Harbour and the rejuvenation of the older marsh. When viewed from Overy Big Hill‡ or Gun Hill‡ the general physiography of

* Cf. Owens and Case, "Coast Erosion and Foreshore Protection," 1908. Ch. V. pp. 48-53.

† F. W. Oliver. "Scolt Head and Blakeney Point." Trans. Norfolk and Norwich Naturalists' Society, XI. Pt. V. 1923-24, p. 573.

‡ The highest "peaks" of the Burnham Overy Dunes.

Overy Hills and Scolt Head Island also suggests a former continuation. Further details of this are given later.

A detailed description of the numerous lateral ridges is unnecessary; an inspection of the map will show their distribution and form very clearly. Only one point need be mentioned—the close agreement in curvature between old and new ridges.

3. The Dunes

The view has already been put forward that Scolt Head Island and Burnham Overy Hills were at one time continuous. Bearing this possibility in mind, it will be convenient to commence an account of the dunes with some reference to those at Burnham Overy.

These Overy Hills are, in many respects, the best developed in the district. As on Scolt Head Island, recent changes have taken place in Overy Hills. For example: About three hundred yards east of Burnham Harbour the north-east (?) winds a year or two back cut a large lunar-shaped opening in the front dune ridge. This opening was about three hundred yards long and up to one hundred yards deep. This has now been completely refilled by sand piled up mainly by north-west winds.*

In a general way the Overy Hills show an arrangement in parallel lines, which are based on old shingle ridges. Many of these shingle ridges are now buried, and their existence is implied rather than known. However, several are still visible, and one in particular running inside and more or less parallel to the present main dune ridge. In one or two places this ridge bears what appear to be recurved ends running back from it. A good view of the main features of these hills can be obtained from the summit of Overy Big Hill or from the Beacon Post on Gun Hill. There are suggestions that they are arranged as those on Scolt Head Island; in several parallel ridges with poorly developed recurved ends. This is true in some parts. However, the inner dunes, whether or not they were originally arranged in this way, are now "dead." The sand is being gradually blown away by the wind, and

* The causes (i.e. winds) of the cutting and filling up of this hollow are those held locally; it seems extremely probable, however, that west and south-west winds have been largely responsible for the filling.

various *remanié* forms are left. Towards Holkham the planting of conifers on Lord Leicester's estate has interfered with the natural development of the dunes.

After crossing Burnham Harbour to the eastern end of Scolt Head Island, the arrangement of dunes in more or less parallel ridges is once again apparent. The inner ridges are the older ; the outer are very recent indeed. In fact, this part of the island (i.e., the extreme eastern end) is rapidly prograding —very considerable additions having taken place in the last twenty-five years (see map). These hills (Norton Hills) continue westwards as far as the low ridge with gaps, including Smugglers' Gap, where they break down. Before reaching the most easterly gap they once again show an older and inner, also higher, ridge, and an outer and newer ridge. These two ridges are separated by a "valley," whose position has been indicated on the map (q.v.). This valley may be traced intermittently almost up to Burnham Harbour. Smugglers' Gap is the name given to the very low stretch in which a new dune ridge is growing. It will be found on the map just to the east of the "Hut Massif."

Privet Hill is a fairly conspicuous dune ridge. It stands back from the main beach and just behind the lowest part of the Smugglers' Gap. The dunes forming it are based on one of the old lateral ridges. This particular ridge runs back from the main beach and then turns south-eastward forming a very long and tapering end. Where the main mass of Privet Hill stands† there appear to be some complexities, so that for a short length it is nearly parallel with the main beach. The dunes on Privet Hill may, therefore, have been formed, in part, when those along the main beach ridge were destroyed. The form of Privet Hill suggests that some of the sand forming the dunes must have come from the north.

The "Hut Massif" affords some interesting features. It is the chief dune mass on the island. Along its seaward face are several "blow-outs" (Windmülde of the Germans, or Caoudeyres of the Gascony coast). These nearly all face north-east. Their general positions are shewn diagrammatically

† i.e. near point D at end of line of section C—D, Plate XVIII.

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"Blow-Outs": Examples in the Long Hill

on the map.* In the case of one or two of them, new sand supplies, coming from the west, are blocking up their mouths. Just to the east of the flagstaff is a large blow-out facing north-west ; this is particularly conspicuous since it presents a face of clean sand. On its seaward side are others, facing more or less the same direction.

Running landwards from here are dunes in various stages of decay which reach as far as the Long Hill. This hill forms a very prominent dune ridge running approximately north and south. The size and development of the dunes suggest that when they were formed there must have been a good sand supply westward of them. This area is now muddy, and is never really dry at low water. As each recurved ridge marks a former end of the island, it appears probable that the entrance to Brancaster Harbour must have remained near this ridge for a considerable period of time. During that period, it may be assumed, there existed large sand flats to the west of it, much as to-day we find large sand banks, which are exposed at low water, to the west of the present harbour. In 1891 the high water mark apparently ran at the foot of this ridge to the gap west of the " Hut Massif."† Several very good examples of blow-outs occur along this ridge ; some of them cut right through it ; others have not yet been able to do so. (Plate XVII.)

Westwards from the " Hut Massif " there is a long and recent addition to the island, with many recurved ridges. Along the main ridge and some of the laterals dunes have grown up, but are only in a very youthful stage of development. This end of the island is a good example of a prograding shore —successive beach ridges are added to its western extremity, and on these dunes gradually form, until newer beach ridges are thrown up, thus depriving the older ridges of their normal sand supply. This tapering western end of the island thus affords a good case of a " Foredune " (Vordune) in its early stage of development.

Two other areas, which are well covered with dunes, remain

* The " Blow-Outs " are shewn on the map as semi-circular or elongate openings ; e.g. the blow-out at the Flagstaff just above the Hut.

† See 6″ O.S. Map, 1891 and a note in Trans. Norfolk and Norwich Naturalists' Society, Vol. XII., Pt. 1. 1924-25, pp. 84-86 and map.

for mention. The first is the great mass to which the name House Hill is given. These dunes rest on lateral shingle ridges and bear much the same relationship to the main beach as does the Long Hill, though they are very much older. Their size and development, too, suggest that, when the ridges on which they stand formed the western end of the island, the then harbour remained in approximately the same position for a considerable length of time.

The second is the long dune ridge known as Butcher's Beach. Together with it may be included Felter's Hill. Presumably these dunes grew when sand flats lay exposed to the south-west and west of these two places.

Finally a few words may be added about the blow-outs. Most of the important ones have been indicated on the map, which also shews their approximate orientation. For the most part they face north-east or south-west or west :—i.e., facing either the dominant or the prevalent winds. They occur quite irregularly and in what were formerly weak places in the dunes. Once bare sand is exposed it is not long before the wind works on it, blowing it away and exposing new material. Gradually the initial, and small, hollow is enlarged to the size of the present blow-outs. In some cases rabbits, having exposed the sand, are responsible for the initiation of these hollows. In others, doubtless, human agency or other factors must be invoked to explain their origin.

4. Factors Governing the Growth of Scolt Head Island

It is a well-known fact that Scolt Head Island has been growing to the west very rapidly of recent years, and its form shows that this has been its normal condition ever since it came into being. We must now turn to the causes of this westward growth. In explaining the growth of similar formations elsewhere appeal is often made to waves, tidal currents, the relation to the greatest fetch of open water, and several other factors.

With a view to ascertaining which of these factors is the most important in the formation of Scolt Head Island, several experiments were made. In order to establish the drift of the water close in-shore with the rise and fall of the tides several tests

were made with floats. It was found that ordinary glass bottles thrown clear of the breakers served best. They floated in large part submerged and were practically unaffected by the winds. Naturally, the experiments (which were made in 1925 and 1926) gave the best results in calm weather.* In 1926 further tests were made with anchored floats, but, although these confirmed the bottle experiments, they did not serve so well.

The main object of all these tests was to obtain the movement of the water close in-shore. Sailors and sailing directions will give the tidal movements well out from the shore. These movements may or may not be the same as those affecting the beach. It is with these latter that we are primarily concerned.

Another point of considerable importance must be noted. The tide has a vertical as well as a horizontal range. Material on the beach worked on at high water is not worked on at low water. Hence, *as far as tidal currents are concerned*, there may be two independent and opposite motions of material on the same beach—the higher part of the beach being "stroked" one way at high water, and the lower parts "stroked" the other way at low water.

Along the main beach at Scolt Head the flood tide runs westward (i.e. with the growth of the beach) up to just about high water.† But the water shallows very gradually here, and, as has been noted above, there is usually a well marked line of separation between sand and shingle on this beach. It is, then, the shingle, almost exclusively, that is worked on at high water. From this it would appear to follow that the flood current alone is responsible for the westward growth of Scolt Head Island. This is very doubtful, and leads directly to the next consideration; the effect of the waves.

Before discussing the actual effect of waves on the shore, it will be well to study, in some detail, the general position of Scolt Head Island and its relation to open water. Further, the prevalent and dominant winds should also be considered here. There is no doubt that at Scolt Head, as everywhere else in Britain, the prevalent winds come from the quarter between

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* See later.

† See Table I.

south and west.* But these may have a noticeable effect on the beach, although they blow from the shore to the sea. The general effect of off-shore winds is to cause the beach to "make." This follows from the fact that a wind blowing from the land causes a *seaward* motion of the surface water, which is sometimes counterbalanced by a *landward* motion of the deeper water. The converse of this is demonstrated by the well known fact that bathing is warmer during an on-shore rather than during an off-shore wind.†

The next point is that winds from west or north-west do not have a great permanent effect on the island. Such winds come from off the Lincolnshire coast and have a comparatively short tract of sea to pass over before striking the Norfolk coast. Hence, unless such winds, which are often very strong, continue uninterruptedly over a period of several days, their effects are comparatively short-lived. But as soon as we pass from north-west and continue round to east we find very different controls. To the north and north-east there is a stretch of open ocean up to Arctic latitudes and winds, which are often violent, blowing over this stretch of water, generate large waves which have a great effect on the beach. It does not necessarily follow that the winds themselves approach Scolt Head with any violence. The waves due to them are generated well out to sea and travel onwards as long rollers long after the impetus has ceased. In fact, it is often noticeable that winds are blowing from quite a different direction when breakers are coming from the north-east. (See examples of observations which are being made by Mr. Chestney, Table II.) Similarly, winds coming from the east or even south-east have a noticeable effect on the beach.

We will now turn to the actual effect of waves breaking on the beach. Suppose a series of large waves approaches the beach from the north-east. The waves will not break parallel

* See Table III.

† At the request of the writer, Mr. Leonard Pinchen made some observations on the effect of wind and waves on the beach at Blakeney, over a period of three weeks in June, 1925, which demonstrated this point clearly.

See also Owens and Case, "Coast Erosion and Foreshore Protection," 1908, Ch. V.

See also below.

with the beach, but will break first to the south-east and gradually roll along (see fig. 2).

The lines numbered 1, 2, 3, 4, represent one wave in four successive positions. It begins to break at A and gradually passes along the beach to B. When a wave breaks there is a strong up-current of broken water, termed the *swash*. Anyone who has watched big waves breaking or has waded in this swash will be convinced of its power to move even large pebbles.

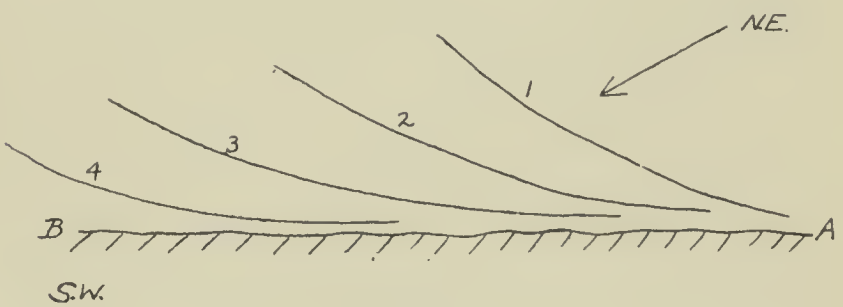


FIG. 2

Suppose, then, a particular pebble is caught by the breaking wave. The swash carries the pebble forward in the direction in which the waves themselves are approaching—i.e., to the south-west. When the upward movement of the swash has ceased, the *backwash* of the wave begins. For various reasons this is not so powerful as the swash,* and naturally acts with the force of gravity, at right angles to the main trend of the beach. If the particular pebble which we are considering is acted upon by this backwash, it will be carried *directly* back to the sea until it meets the swash of the next approaching wave. The same process will then be repeated. Thus the pebble moves onwards in a series of curves such as those shewn in the diagram (fig. 3).

* D. W. Johnson, "Shore Processes and Shoreline Development," p. 93. "The landward component of this alternating current is as a whole the stronger, because the return current suffers a loss of velocity due to the friction which acts continuously, and a loss of volume due to percolation of the water into the crevices between the sand and coarser material composing the beach. Where the beach slope is very steep, however, the seaward current may be the more effective of the two because it works with gravity, while the landward current must propel the débris up the slope against the pull of gravity." [The beach at Scolt Head slopes very gently.]

Numerous experiments have been made on the nature of this beach drifting. For a full account the reader is referred to D. W. Johnson's " Shore Processes and Shoreline Development," pp. 94-105. The writer has made similar experiments

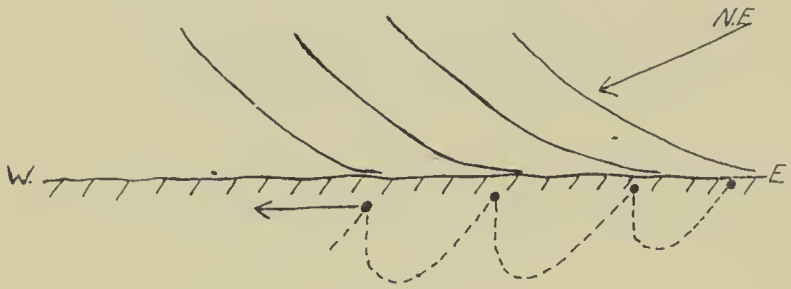


FIG. 3

with marked pebbles both at Scolt Head Island and Blakeney Point, and these leave no doubt of the efficacy of the process in these two places. The *general* motion of such pebbles is westward.

The following table, from observations at Scolt Head, gives some idea of the movement which may take place in calm weather :—

No. of Pebbles.	Distance Travelled.	Direction of Movement.	Remarks. [Size of pebbles, major and minor axes.]
1	4 yards	To West	8″ x 4″
2	6 ,,	,,	7″ x 4″ and $2\frac{1}{2}$″ x $2\frac{1}{2}$″
3	21 ,,	,,	
2	29 ,,	,,	
1	38 ,,	,,	
1	56 ,,	,,	

The movements shewn above all took place between the morning and evening of Wednesday, July 7th, 1926. Except for very large pebbles, there seemed to be little selective action on the part of the waves, medium-sized and small pebbles moving equally fast. A similar experiment was made on July 5th, when a swell was running. The results were similar, but the number of pebbles found was less. At Blakeney Point some marked pebbles were put down on September 19th, 1926, in very

calm weather. No appreciable movement took place during the first tide† acting upon them. A moderate gale sprang up from the north-west on the 20th, and next morning two pebbles were found *east* of their original position at distances of 53 and 55 yards, and one other at a distance of 139 yards. The remainder were probably buried, the beach having been "combed down." (It will be remembered that Blakeney Point, like Scolt Head Island, has grown to the west, and hence this motion of the pebbles is in opposition to the growth of the beach as a whole, but not to the flood current at Blakeney, which there runs eastwards.) Under rather similar conditions, some pebbles put down on Scolt Head beach shewed a similar eastward movement up to about 10 yards. These were placed high on the beach, quite near the dunes, and were acted on only for a short period at high water (September 24th and 25th, 1926).

It has been remarked above that in calm weather it is easy to note the direction of tidal currents close in-shore. In rough weather it is not so easy. The off-shore bottom is very shallow and the effect of large waves is appreciable down to the bottom. As a consequence, in rough seas, the whole motion of the water within a variable distance from the shore (e.g., up to about one hundred yards or more) may be affected by the breakers, whose power is then considerably greater than that of the tidal currents.

There are, then, two main factors at work in the formation of Scolt Head Island :—The tidal currents and the waves. At present it is hardly possible to discriminate between them, but results point to the waves being the more important. But another point must be borne in mind. When waves are coming in from the east and north-east, they are working with the flood current. It follows from this that their combined effects ought to be additive. At the same time, the breakers, if of any size, stir up the sand at moderate depths and the progressive movement of the water westwards with the tidal drift must naturally affect this stirred-up material, which, in fact, should

† The pebbles were put down in such a place that they could only be acted upon by the waves from about half flood to half ebb.

be carried along with the tidal current in intermittent suspension.

On the other hand, when the waves are working against the tide, the effects should be less, the one factor to some extent neutralizing the other. But, so far as the writer's observations go at present, it seems that the waves have the greater power.

In order, if possible, to prove this point, Mr. C. Chestney is making long-period observations on Scolt Head Island. A sample form is given (Table II, p. 253). Broad generalisations should not be made from such a short period as one week, but even here the effect of north-west waves is clear. Further, it illustrates the independence of wave and wind approaches. It is hoped that, when such observations have been made for a year or so, an analysis of the results will bring out the interaction of the several factors involved.

One further point calls for notice. A strong on-shore wind, with waves acting with it, alters the profile of the existing beach in such a way that much shingle is carried seaward with the strong undertow which naturally takes place. At the same time the higher parts of the beach may be steepened or a new ridge may be added. If the wind and waves are from east or north much of this material which is combed down in this way is also carried westwards. This is later built up into new ridges in calmer weather. These new ridges gradually merge into the main beach in course of time.

Table III (p. 254) shows that winds from the quarter between south and west are, in number, considerably greater than winds from any other quarter. It is just possible these may have an indirect effect on beach drifting. Suppose such winds to blow for several consecutive days. The surface water should, then, be carried north-eastwards. To counterbalance this there may be a south-westerly motion of the deeper water. Whether this is so it is impossible to say, but if such a motion does exist it should help in transporting material westwards along the beach.

There is also another factor to be considered. An offshore wind may set up waves coming in from the opposite direction to that in which the wind is blowing. South-west winds may, then, generate small waves coming in from the north east. These must naturally help in transporting the

shingle westwards. It must be remembered, however, that such waves are by no means always set up by off-shore winds. (See Table II.)

Finally, it should be remembered that the general shallowness of the off-shore zone has the effect of reducing wave action very rapidly. Big storm waves will reach the beach during a storm, but, soon after the motive force of the storm ceases, the waves begin to decrease in size on account of friction in passing over the shallow sea-bed. A similar effect is noticeable at high and low water; at high water quite big waves easily reach the shore, but at low water these soon shew a tendency to decrease in size.

Part II

The Mapping of Scolt Head Island

By O. D. Kendall

The accompanying map is based on the six-inch map of the Ordnance Survey, revised up to 1904, and is reproduced by permission of the Director-General of the Ordnance Survey. It has been compiled from a plane-table sketch carried out during July of this year (1926). An open sight alidade was used with the plane table which was of the ordinary R.E. pattern. Sometimes, as in the case of some of the shingle ridges at the western end of the island, traverse methods were used, distances being measured with a one-hundred foot steel tape.

The names used on the map have been obtained, and verified, from local sources.

The two sections (figs. 4 and 5) shewn were taken—

1. Through the main dune line near the Hut, shewn on the map by the chain-dotted line A B.
2. Through Smugglers' Gap, shewn on the map by the chain-dotted line C D.

These sections should not be taken as representative of the dunes as a whole. The main dune ridge naturally varies both in width and height.

On the six-inch Ordnance Survey Map of 1904, the island is shewn as having a length of 3 miles 660 yards, measured in a

straight line from S, the eastern end of the Main Dune line, to the tip of the then Outer Point. The length is now (July, 1926) 3 miles 1,120 yards, and thus there has been a gain of 460 yards in twenty-two years. This measurement was taken in a straight line from S to the end of the Outer Point. If, however, measurements are taken—

1. Between the extreme ends of the Outer Point on the Ordnance Map, and the present Outer Point, the gain is 600 yards (measured in a straight line).
2. Round the spit from U to the end of the present Outer Point, the gain is 1110 yards. [U represents the position of the high water mark on the Ordnance Map (of 1904) at the junction of the Outer Point shingle ridge with the main ridge.]

It is proposed in this account to indicate briefly the various changes that have taken place since the revision by the Ordnance Survey in 1904. The following features will be treated in some detail :—

1. Shingle Ridges.
2. Dunes : gaps and wind-blown hollows.
3. Brancaster Harbour Channel.
4. Miscellaneous.

As far as possible, the Burnham or eastern end of the island will be taken as a starting point in the descriptions.

1. Shingle Ridges

Between the eastern end of the island and House Hill six ridges in succession run landwards from the main dune line. No. 1 ridge, nearest to the east end of the island, is comparatively short. It has a definite bend to the south-east and is dune-covered for the greater part of its length. Further to the west, ridges Nos. 2 and 3 run back in the same approximate direction. They have the characteristic bend to the south-east and join together at their distal extremities.

Ridges Nos. 4, 5, and 6 follow the same general direction. These are all of considerable length, the longest exceeding eight hundred yards. They are, for the most part, covered with dense vegetation. Each ridge has a very definite curved end ; the approximate parallelism of their directions may be noted in passing. No. 6 ridge shews a secondary near the point of

inflexion to the south-east. No. 5 ridge could not be definitely traced to the main dune ridge owing to the very thick growth of vegetation. These ridges, with the exception of a short portion of No. 6, are not shewn on the Ordnance Survey Map.

From the inland end of House Hill two shingle ridges, Nos. 7 and 8 on map, run back in a south-easterly direction for over three hundred yards. Both ridges are now largely overgrown by vegetation. At the extremity of ridge No. 8 there are older masses of shingle (as shewn on map) on either side of it.

At the Smugglers' Gap, between House Hill and Privet Hill, the spread of shingle is much more extensive than that shewn on the Ordnance Survey Map of 1904 ; shingle is in fact almost continuous between the two hills and runs back for some 350 yards from the main beach. In most places, away from the sea, it is overgrown by vegetation. Four shingle ridges, marked 9, 10, 11, and 12 on the map, which run inland from Smugglers' Gap, may, however, be picked out, the most westerly ridge being continuous with Privet Hill. These ridges are all comparatively low and flat, though occasionally, as in the case of No. 11, they are rather better defined at their extremities. The ridge at the inland end of Privet Hill actually runs much farther back than is shewn on the Ordnance Survey Map, and it abuts on the creek (see map).

Between the Long Hill and the Butcher's Beach ridge, there are several smaller shingle ridges. These, with the exception of ridge No. 15, are not shewn on the Ordnance Map. Between these ridges there are several spaces, which were shewn on that map as shingle patches ; the shingle is now covered with mud and sand. Probably in such areas the shingle is from time to time mud-covered, and such changes seem to be comparatively frequent, e.g., at an interval of one month such an alteration has been noted on a small scale near Felter's Hill. Ridge No. 17 is noteworthy, both on account of its recent growth and very definite looped end. The parts of the ridge marked No. 16 are practically continuous, and vegetation is growing on them in places.

Between Long Hill and the Outer Point there are now eleven shingle ridges, numbered 20 to 30 on the map. This part of the island has changed considerably, and much has been added to it since the Ordnance Map was published. All

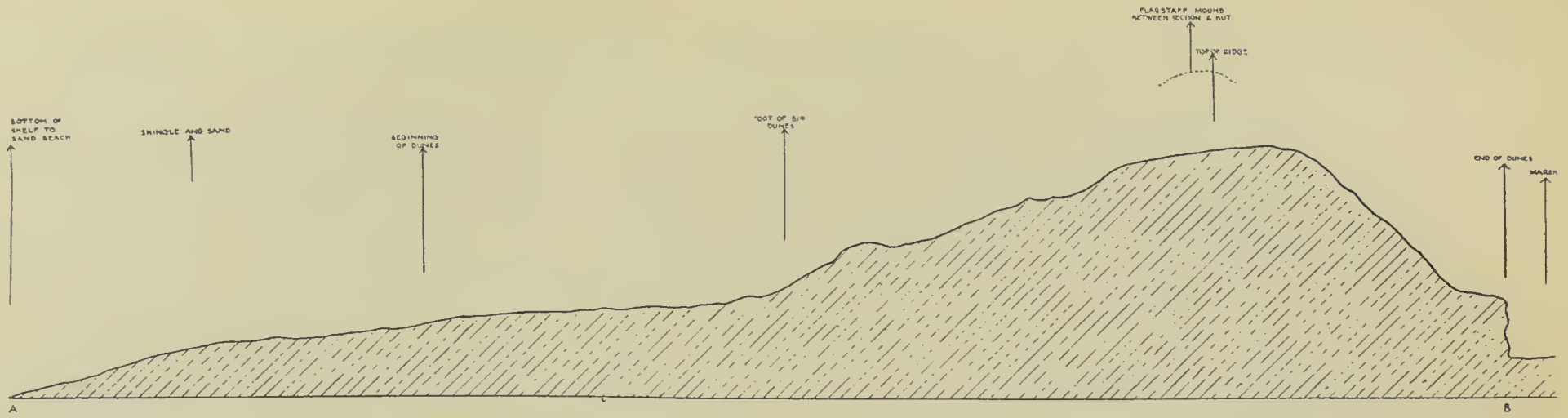


FIG. 4. Section A—B, 12 paces East of Flagstaff, East of Hut—The Dune Line

FIG. 5. Section C—D, 800 paces East of Flagstaff—Smugglers' Gap

Horizontal Scale 1 inch = 40 yards
Vertical Scale 1 inch = 40 feet
(in both figures)

the ridges, with the exception of the Outer Point, No. 30, are within the area covered by dunes. These ridges tend to occur in pairs, the pairs in turn tending to coalesce. In practically all cases they shew a pronounced bend, in sympathy with that of the Outer Point ridge, i.e., they bend back on their original courses. The name Outer Point should apply to the end of the outermost ridge at any date, and will thus change its position from time to time. Ridge No. 25 shews a termination at X and is there joined by the looped ridge No. 26.

At the Brancaster end of the Long Hill the Ordnance Map shews a stretch of shingle, but no true ridges. Now there are two very definite ridges, each shewing a marked bend in approximately the same direction as in the case of those of the Outer Point area. These are numbered 18 and 19 on the map. It will be realised that the widths of the shingle ridges may shew considerable variations, since the effects of even one storm are often very marked. The widths shewn on the map, therefore, should be considered as those which apparently best represent ordinary conditions.

2*a*. The Dunes.

At the Burnham end of the island (i.e., the east end) the breadth of the main dune ridge has increased, especially at the point marked Y, where the gain is about sixty yards. In this area a new dune ridge is being built on the seaward side of the older dunes (note point Z). This is a comparatively recent addition, for, on the Ordnance Map, the dune line is here shewn as a smooth curve on its outerside. Westward from this area, the dune ridge, in general, shews a slight recession. It becomes relatively complicated near Smugglers' Gap, and in this part, especially at the eastern end of the gap, small breaks in the dune line change their positions at fairly frequent intervals.

On the lateral shingle ridges between the Burnham end of the island and House Hill there are practically no dunes shewing save on No. 1. In Smugglers' Gap the Ordnance Map shews a complete and long break in the dunes. Now, however, new dunes are forming. These are at present almost continuous, though of small extent. They are also very low (see section C D).

The dune lines not yet mentioned, such as Privet Hill, shew very little change save for wind-blown hollows which are noted later. To the south of the Long Hill up to the branching points of the shingle ridges No. 18 and 19 there has been some recent dune development. These new dunes are practically continuous with the main dunes of the Long Hill, which shew very definite traces of wind erosion at the Brancaster end.

The dune on Felter's Hill, though so small in extent, agrees with the position shewn on the Ordnance Map.

The main dune belt shews a gain in length westward of 330 yards, but between the Long Hill and its western extremity, as shewn on the Ordnance Survey Map, there has been very little change in its breadth. There is a well-marked gap at T, near the Bird Watcher's hut, after which the dunes are continuous for a further 390 yards to the west. Embryo dunes are also appearing on some of the lateral ridges, e.g., on No. 29.

2*b*. Dune Gaps and Wind-Blown Hollows

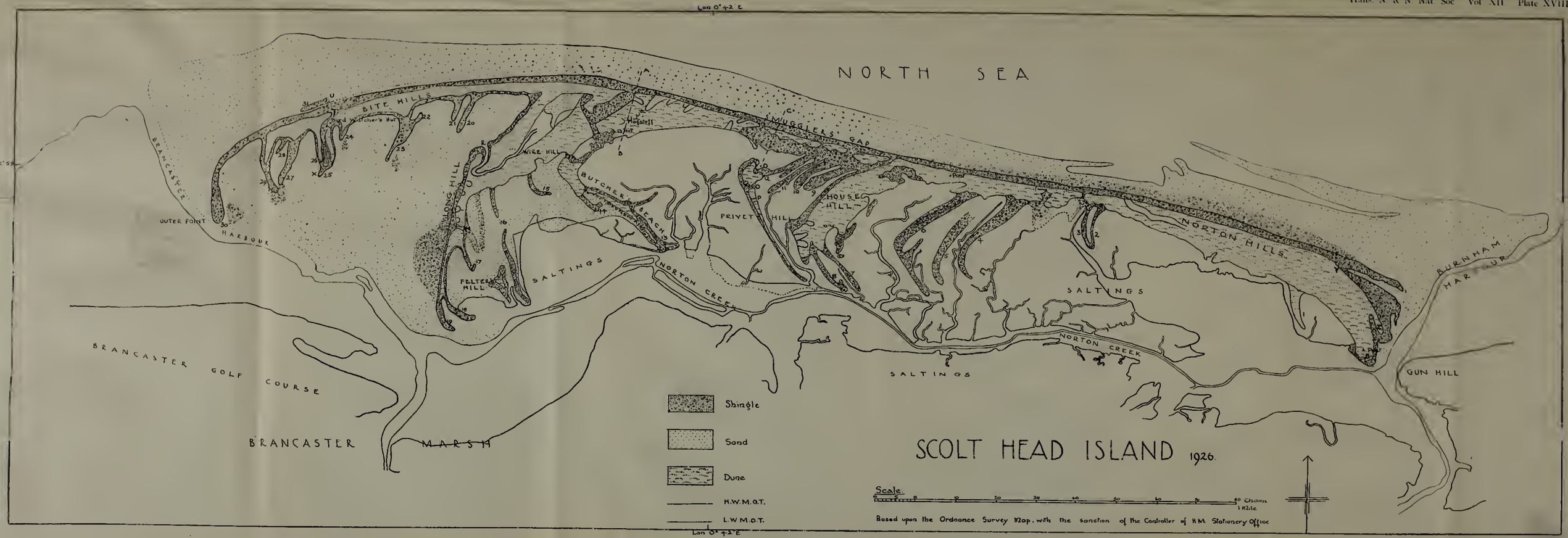
In the dune ridges gaps, which are not marked on the Ordnance Map, occur at the points N on Long Hill, and at O and P on Privet Hill. The significance of the approximate alignment and direction of these gaps is suggested in Part I. of this paper.

The wind-blown hollows in the Norton Hills, House Hill, Privet Hill, the Main Dune ridge, and Long Hill are shewn diagrammatically. They are also described in Part I. of this paper. An attempt has been made on the map to indicate their approximate direction and extent. They are seen in many stages of development, varying from a few square yards in area to wide open gullies cutting far into the dunes.*

3. Brancaster Harbour Channel

Since 1904 the harbour channel has swung round, so that its seaward end has now taken an approximate north-westerly direction. This is a change from a direction only slightly north of west and represents a turning movement of the actual mouth of some 1030 yards. The present course of the eastern side of the channel, as shewn on the accompanying map,

* See footnote, Page 237.


Lon 0°42 E
NORTH SEA
BITE HILLS
Fletcher's Hut
Hogsell
SMUGGLERS GAP
WIRE HILL
LONG HILL
BUTCHER BEACH
PRIVET HILL
HOUSE HILL
NORTON HILLS
BRANCASTER HARBOUR
OUTER POINT
FELTER HILL
SALTINGS
NORTON CREEK
BURNHAM HARBOUR
GUN HILL
BRANCASTER GOLF COURSE
BRANCASTER MARSH
Shingle
Sand
Dune
H.W.M.O.T.
L.W.M.O.T.
Lon 0°42 E
SCOLT HEAD ISLAND 1926.
Scale.
Based upon the Ordnance Survey 1/2500. with the sanction of the Controller of H.M. Stationery Office

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is an approximation based on readings taken with a prismatic compass and measurements with a steel tape. It will be seen that the extreme end of the Outer Point is now on the margin of the channel.*

4. Creek Through the Long Hill

The Ordnance Map of 1904 shews the main dunes of the Long Hill as firmly established and continuous with the main dune belt along the seaward side of the island. They are now severed, however, and a winding creek (marked R on map) runs through the ridge, terminating in the area between Wire Hill and the main line of dunes. At this stage, it is difficult to account for tnis break-through, or to say whether it occurred on the east or the west.

The ridge No. 31, near the western end of the island, is comparatively small and indefinite, and gradually merges into the shingle of the main beach. It is, however, for some distance separated from the main beach by a well marked gully. The continuation of this gully, shewn on the map by a dotted line, is at present traceable for a considerable distance.† This is probably only a temporary ridge, and was formed very recently during a period of high tides.

The two accompanying sections (figs. 4 and 5) were levelled in the summer of 1925.

* Alterations have also taken place in Burnham Harbour, which now runs almost due north. These changes have not been indicated, as they are outside the scope of the present paper.

† Observations by Mr. Chestney.

TABLE I

OBSERVATION FORM.—Date, Aug. 18th, 1925; Weather, fine; Sea, slight. Place, Scolt Head. High water about 6 p.m. Summer Time.

Time	Drift of Float	Direction of Waves	Direction of Current	Direction of Wind	Remarks on Float
8 a.m.	—	N.N.E.	—	N.E. (strong)	Near to shore; westward movement with waves.
8.30					
9.0					
9.30	E.N.E.→W.S.W.	N.N.E.→S.S.W.	E.→W.	N.E. (moderate)	
10.0	E.N.E.→W.S.W.	N.N.E.→S.S.W.	E.→W.	E.N.E. (moderate)	
10.30	E.→W.	N.→S.	E.→W.	E.N.E.	Observations taken beyond breakers.
11.0	E.→W.	N.→S.	E.→W.	E.N.E.	*Not* beyond breakers.
11.30	E.→W.	N.→S.	E.→W.	E.	Too far out to follow owing to slope of shore.
Noon	E.→W.	N.→S.	E.→W.	E. (moderate)	Beyond breakers.
p.m.					
12.30	E.→W.	N.→S.	E.→W.	E.	
1.0	E.→W.	N.→S.	E.→W.	E. (light)	Good distance out beyond breakers.
1.30		No observation taken.			
2.0	E.→W.	N.→S.	E.→W.	E.N.E.	Beyond breakers.
2.30	E.→W.	N.→S.	E.→W.	N.E.	Beyond breakers.
3.0	E.→W.	N.→S.	E.→W.	E.N.E.	Channel between main sea and beach.
3.30	E.→W.	N.→S.	E.→W.	N.E.	
4.0	E.→W.	N.→S.	E.→W. and in-shore	E.N.E.	Tide rising quickly. Apparent beginning of oscillations.
4.30	E.→W.	N.→S.	E.→W. and in-shore	N.E.	No movement outside breakers.
5.0	No movement	discernible.	Slightly in-shore if any.		
5.30		No observation taken.			
6.0	W.→E.	N.→S.	W.→E.	N.E.	
6.30	W.N.W.→E.S.E.	N.→S.	W.→E.	N.E.	Brought in rapidly by breakers.
7.0	W.→E.	N.→S.	W.→E.	N.E.	Beyond breakers.
7.30	W.→E.	N.→S.	W.→E.	N.E. (light)	Beyond breakers.
8.0	W.→E.	N.→S.	W.→E.	N.E.	Beyond breakers.

TABLE II

OBSERVATION FORM. Week ending July 25th, 1926

Date.	Time.	Direction of Wave Approach.	Direction of Wind.	Effect on Movement of Sand and Shingle.	General Effect on Beach.	Remarks.
July 19	Morn 9 a.m.	From N.W.	S.S.W.	None	None	Wind off land: no waves to speak of.
	Even 7 p.m.	From N.W.	S.W.			
July 20	Morn 9 a.m.	From N.W.	W.	None	None	
	Even 6 p.m.	From N.W.	S.W.			
July 21	Morn 8 a.m.	From N.	N.W. by W.	None	None	Strong wind. 4 stones put down · 2 moved 10 yds. to east, others buried.
	Even 8 p.m.	From N.	W.			
July 22	Morn 10 a.m.	From N.W.	S.W.	None	None	
	Even 7 p.m.	From N.W.	S.S.W.			
July 23	Morn 7.30 a.m.	From N.W.	S.W.	None	None	
	Even 4 p.m.	From N.W.	S.W.			
July 24	Morn 8.30 a.m.	From N.W.	S.W.	Big tide causing new ridges on beach, which is moving eastwards	In parts washing away: making up in others	Waves running too strong; stones buried.
	Even 6 p.m.	From N.W.	S.			
July 25	Morn 9.30 a.m.	From N.W.	S.W.	Very big tide at night; shingle and sand in movement	None	
	Even 8 p.m.	From N.W.	S.W.			

TABLE III

TABLE OF WIND OBSERVATIONS FROM JULY, 1925 TO JUNE, 1926

Month.	N.	N.N.E.	N.E.	E.N.E.	E.	E.S.E.	S.E.	S.S.E.	S.	S.S.W.	S.W.	W.S.W.	W.	W.N.W.	N.W.	N.N.W.	Calms.	Total.
1925																		
July	6	0	16	2	14	0	9	4	5	2	16	1	18	2	8	3	18	124
Aug.	4	0	9	0	11	0	8	3	10	3	46	1	18	1	3	0	7	124
Sept.	14	0	2	0	0	0	7	1	6	2	28	3	10	9	30	1	7	120
Oct.	14	2	4	0	0	0	4	2	8	9	26	2	14	1	10	0	28	124
Nov.	9	2	12	0	18	2	6	1	15	0	8	3	6	2	15	2	19	120
Dec.	2	0	8	1	5	0	7	0	15	0	45	1	14	0	17	0	9	124
1926																		
Jan.	0	0	9	0	2	0	22	0	23	1	51	4	0	0	1	0	11	124
Feb.	2	0	2	0	13	2	13	0	7	1	49	0	4	1	3	0	15	112
March	6	1	6	1	26	0	1	0	4	0	42	8	12	2	1	0	14	124
April	5	0	16	0	20	0	10	0	6	0	17	0	25	1	4	0	16	120
May	7	0	26	1	19	0	4	0	15	0	27	2	3	0	14	0	6	124
June	15	3	6	3	6	2	7	2	15	0	31	1	6	0	0	1	22	120
Totals	84	8	116	8	134	6	98	13	129	18	386	26	130	19	106	7	172	1460
Percentages	5.75	0.54	7.96	0.54	9.18	0.41	6.71	0.89	8.84	1.24	26.44	1.78	8.90	1.30	7.26	0.47	11.78	99.99

NOTE TO TABLE III.—This table has been compiled from data supplied by H.M. Coastguard at Brancaster Staithe. Four wind observations were made each day, giving a total of 1460 observations for the year, July, 1925 to June, 1926. To simplify [illegible] dates been referred to sixteen points of the compass only.

BRITISH
MUSEUM
26 JAN 27
NATURAL
HISTORY.

CENTENARY OF THE NORWICH MUSEUM, OCT. 25TH, 1925
The Ceremony in the Keep
The Director of the Victoria and Albert Museum
Mr. Eric Maclagan, speaking

X

CENTENARY OF NORWICH MUSEUM

By F. Leney, Curator

The celebration of the Centenary of the Norwich Museum took place on October 25th, 1925, and was honoured by the presence of H.R.H. the Duke of York, and the Directors of many British, French, and Belgian Museums and Art Galleries. The British Museum of Natural History was represented by Dr. W. T. Calman, F.R.S., the Cambridge University Museum by the Director, Mr. C. Forster-Cooper, M.A., the Rothamsted Experimental Station by the Director, Sir John Russell, F.R.S., and this Society by the President, Dr. E. H. Hankin, M.A., the Secretary, Dr. S. H. Long, and the Treasurer, Mr. Robert Gurney, M.A. In making a tour of the Museum, the Duke was particularly interested in the fine examples of African Big-game, and in his official speech asked to be allowed to re-echo the wish expressed by H.M. the King, thirty years ago, " that the prosperity of this ancient and loyal City of Norwich may long continue, and that the Norwich Castle Museum may have a long career of increasing usefulness."

The formation of a Museum in Norwich must have been the outcome of a general quickening of interest in scientific matters in the first quarter of last century, but the idea was definitely mooted at the Annual Meeting of the local Literary Institution on October 22nd, 1824, when the Committee was authorised " to adopt such measures as may best promote the establishment of a Museum and may render it of the greatest avail and most general utility and yet of the least possible expense to the funds of the Institution." The Museum was established in 1825 in a room at the Literary Institution, a building on the site of the present Haymarket Picture House, and most of the early gifts were mammals, birds or other Natural History specimens. These accessions were all recorded in the registers of the time, which have fortunately been preserved and serve as most useful records ; many of the specimens are still in the Museum. For instance, the register for 1825 has items :—

Richard Taylor, Esq.,—Arranged series of fossil shells from the chalk, craig, and alluvial strata.

Thos. Brightman, Esq.,—188 shells, comprising most of the general and some rare species.

Colonel Harvey,—An Armadillo, a bow and arrows.

Captain Manby,—Skin of a Polar bear, skull of a Polar bear, skull of a grampus, skull of a sea unicorn, horn of a unicorn.

Rev. J. Burrell,—Various insects, an armadillo, specimens of shells.

Mrs. R. Taylor,—18 specimens of minerals, 74 shells.

Mr. Lilly Wigg,—The eggs of the starling, water hen, quail, kestrel, coot, jackdaw, tern and plover.

Even in the beginning the so-called "modern" idea of making separate and more detailed collections for the use of students seems to have been evolved, as witness the following recommendation in an early Museum report :—" It appears to the committee that the best means of attaining the object in view is by directing the principal attention at present to collecting the types of the modern genera, in the various classes of natural history. Though some sacrifice may be made by this plan of the more showy and popular methods of forming a Museum, your committee feel convinced it is the only system by which a scientific acquaintance with the objects collected can be promoted, and the *utile et dulce* of such an institution enjoyed."

The first President of the Museum was Sir James Edward Smith, F.R.S., and the list of subsequent presidents contains names equally distinguished in the world of science and literature, viz. : the Rev. Professor A. Sedgwick, F.R.S., Rev. Wm. Kirby, F.R.S., Mr. Dawson Turner, F.R.S., Sir John Boileau, F.R.S., Mr. Thomas Brightwell, F.L.S., and Mr. J. H. Gurney, F.Z.S. The office of Curator was held from 1851 to 1910 by Mr. James Reeve, F.G.S. He was one of the original members of our Society and in the early years of his life worked enthusiastically in the crag pit at Bramerton, many of the shells found by him being of great service to Searles V. Wood and F. W. Harmer in preparing their monographs on the Crag Mollusca.

From small beginnings and with the impetus of much keen interest the Museum has developed through the munificence of many local families such as the Gurneys, the Buxtons and the Colmans, until to-day it is one of the most important

Museums in the provinces. Our Proceedings for the years 1887 to 1901 contain Notes contributed annually by the late Mr. Thomas Southwell, F.Z.S., on the additions to the Natural History Collections in the Museum. The Notes were discontinued in 1913 owing to the need for economy in the expenditure on printing. These annual reports doubtless had the effect of bringing before the notice of our members the desirability of augmenting the collections by specimens in their possession. To take one noticeable and popular example, i.e., " Big Game Trophies " ; about 1902 the Museum possessed some dozen skulls and horns of Cape Buffalo and African Antelopes, whereas at the present time the collection consists of many hundreds of animals and heads, mounted in a most realistic manner. The Geological Collection was always of interest to the members of the old Museum Society and although it suffered in the course of many re-arrangements, the well lighted and spacious gallery devoted to Geology is a special feature of the Castle Museum. The collection comprises those formed by the Rev. John Gunn, Miss Anna Gurney, Caleb B. Rose, Robert Fitch, J. J. Colman, the Rev. F. A. Buxton and others.

The collection of birds arrest the attention of most visitors, and, although other collections are good and comprehensive, the Norwich Museum is generally known for its birds. Mr. J. H. Gurney, in 1855, gave a lecture in St. Andrew's Hall, Norwich, " in illustration of the Raptorial specimens in the Museum," a group which was already ahead of any family of birds there represented. After this date, Mr. Gurney's interest was solely with the Raptores and every year the Museum Reports record a large number of rare and important additions to the collection. After his death in 1890 his son, Mr. John Henry Gurney, enriched the collection with many valuable additions, which he was able to obtain by means of a list of *desiderata* sent out to collectors and sportsmen in all parts of the world. The collection taken as a whole is a memorial of the life-work of an ornithologist of world-wide repute and the birds in hundreds of instances are the types on which Mr. Gurney based his studies and conclusions as recorded year by year in " The Ibis." One special feature of the Gurney Collection is the illustration of the geographical range of a bird, as

for instance the Peregrine Falcon from thirty-six widely separated localities, such as Norfolk, Egypt, Siberia, India, Japan, North America, Greenland and South America.

The study of mankind is illustrated by large and varied collections exhibited in the Keep. A few years ago a desire to effect an innovation in the arrangement of the antiquities resulted in a scheme for the visualisation and history of "Norwich through the Centuries," beginning with Prehistoric Man. With the help of the late Mr. W. G. Clarke, F.G.S., a case was arranged showing the skill attained in the fashioning of arrow heads, axes and tools, and also the life history, as far as it is known, of man in each successive stage of his development.

The dominant feature of museum work at the present time is the provision of Introductory Cases to the study of Birds, Mollusca, Echinodermata, Dentition, etc. These cases arouse attention and, in addition to being of service to students, are of value to visitors who wish to understand the economic and other features of the collections.

The interest of the citizens of Norwich has been maintained in the collections largely through the publicity given in the newspapers to Museum lectures organised by the Norwich Museum Association. This Association was founded in 1907 for the study and further utilisation of the Museum collections and for the dissemination, by means of Lectures and Discussions, of information on subjects connected with Natural Science which may be of benefit to Agriculturists, Horticulturists, Teachers, Students and others.

Probably the most successful venture ever undertaken in the history of the Museum is the scheme for demonstrations to school children, with a view to encouraging a love of Natural History. The Education Authority appointed a qualified teacher having special knowledge of Natural Science, and every child in the senior classes of the Council Schools attends at the Museum once a week for twelve weeks for the purpose of receiving elementary instruction in subjects illustrated in the Museum collections. During the year 1925, there were 18,596 attendances at these demonstrations, in addition to 1,160 scholars who visited the Museum in organised classes for the purpose of general instruction.

This brief notice of the foundation and growth of the Norwich Museum during the past century would be incomplete without mentioning that, since the foundation of our Society in 1869, the monthly meetings have been held in the Museum, and it is beyond question that the success of the Norwich Castle Museum is due to the generosity and interest evinced by members of our Society.

XI

NORFOLK AND NORWICH NATURALISTS' SOCIETY

Report of the Junior Branch for 1925-26

In his Presidential Address in 1919 Mr. E. Bidwell made the suggestion that a Junior Branch of the Society should be founded, but the suggestion was not acted upon until 1925. At a general meeting of the Society on January 27th, 1925, a resolution was passed that such a branch be formed, with Miss Barbara Waterfield as Hon. Secretary and the following members as a Committee :—The President, Capt. Lloyd, H. J. Howard, R. Gurney, D. Payler, W. C. Easter, and Dr. S. H. Long.

The Junior Branch now consists of 31 members, and has held meetings during each of the school holidays. The first of these meetings was in the summer holidays of 1925, when the members met at Attlebridge and went for a walk through the woods and water-meadows. Though nothing of great botanical interest was seen, some members found caterpillars of the Eyed Hawk moth, feeding on willow.

In the Christmas holidays the Branch met at Norwich Museum, when Dr. A. H. Evans, of Cambridge, gave a talk on the birds seen on an imaginary walk through part of Northumberland.

In the Easter Holidays, 1926, an expedition was made to Sutton Broad. Mr. Robert Gurney provided boats and took us down the broad. The most interesting part to most of the members was hearing the Bittern booming, which most of them had never heard before. Mr. and Mrs. Robert

Gurney kindly asked the whole party back to tea at Ingham, and afterwards our host took us round his museum and showed us his bird skins, pointing out the quickest way of distinguishing birds by their plumage.

On Sept. 7th the members made an expedition to Hickling Broad. Miss Turner conducted the party round "Swim Coots," where a number of interesting birds were seen including a Greenshank and a Smew. Afterwards she was kind enough to give the party tea upon her island.

B. WATERFIELD,
Hon. Sec.

XII

MISCELLANEOUS NOTES AND OBSERVATIONS

THE OLEANDER HAWK MOTH, *Daphnis* (*Chaerocampa*) *Nerii*, IN EAST NORFOLK.—A female specimen of this exceedingly rare moth was caught at Hemsby (near Gt. Yarmouth), on September 8th, 1926. It was resting on some palings by the roadside and had laid two eggs, which were however unfertile.

This moth is an inhabitant of Africa and ranges eastward through Asia Minor to India. In Europe it is only found at all commonly on the Mediterranean coast.

The larva feeds on *Nerium oleander*, preferring the flowers to the leaves; in confinement it will thrive on *Vinca minor*. It has been found in England on only one or two occasions but has not been reared.

D. nerii was first recorded as English in 1835 by Stephens who described a specimen taken in September, 1833, at Dover. Up to 1907 only 25 occurrences are mentioned by South, but since then records have been more frequent. (There have been two others this year, one from Niton I.O.W. on September 7th, and a doubtful one from Holbeach.) The Hemsby specimen is believed to be the first ever recorded in Norfolk.

There is considerable doubt as to how this moth reaches our shores. An analysis of the records of its capture shows that it has occurred most frequently in the south-east of England, especially on the coasts of Kent and Sussex. This

might be taken to indicate that it has flown over from the Continent. As the nearest breeding place, however, is over 500 miles away, the almost perfect condition of most of these specimens weakens the hypothesis.

It has been suggested that the pupa is imported amongst foreign fruits; but it seems more likely that the pupa is introduced amongst the roots of exotic plants, especially of *Nerium oleander*, which has a place in many English conservatories.

Although no definite conclusion can be drawn, it is fairly safe to assume that the majority of specimens of *Daphnis nerii* caught in England have been brought at least part of the way by external means.—K. Bagnall-Oakeley.

The Distribution of the Crayfish, *Potamobius Pallipes*, in Norfolk.—The distribution of the Crayfish in Norfolk is a matter on which further information is required, and the following notes embody all that I have been able to ascertain regarding it.

River Bure.—Mr. W. L. Buxton informs me that his father introduced four hundred French Crayfish in 1881 into the tributary at Bolwick (the Mermaid), but that they seemed to disappear in a year or two. It is not known to what species they belonged. The late Mr. R. W. Purdy of Aylsham, writing to me in 1907, said that he was aware of this introduction by Mr. Buxton, but believed that the animals did not establish themselves nor travel up the stream to Mr. Buxton's property half a mile above.

Mr. Purdy sent me Crayfish in 1908 taken from the Bure at Aylsham and also shells, picked up on the bank at Ingworth, of individuals which had apparently been eaten by rats. This summer Mr. W. L. Buxton found a recently killed and partly eaten specimen on the river bank at Itteringham.

According to Mr. Purdy, Crayfish abound in the stream which flows through the lake at Thurning.

In 1904, Mr. F. Balfour Browne took specimens from a small stream entering the Bure just below the bridge at Ingworth, and also in Scarrow Beck which flows into the Bure at Blickling.

River Yare.—Crayfish have been taken from the Yare at Keswick by Mr. G. H. Gurney, and a specimen from Cringleford is preserved in the Norwich Museum.

At Taverham Mill (R. Wensum) Crayfish are abundant, and I have caught numbers of them there myself. It is said to occur also at Attlebridge. Probably it inhabits all the upper waters of the Wensum since one was taken at Ryburgh Mill recently by Mr. E. L. Smith of Wells.

River Glaven. Mr. Balfour Browne found Crayfish in the Glaven at Thornage in 1904, and Mr. N. R. Rippingall tells me that he used to get a lot of them at Glandford Mill about thirty years ago.

With regard to the rivers draining towards the west the only information received at present is that Crayfish do not occur in the R. Nar (Mr. Philip Gurney).

The Crayfish should be looked for in holes in banks, and under stones in running streams, and it is not normally an inhabitant of still waters. It is, however, found in the " lodes " of Wicken Fen, and I have kept specimens taken at Taverham in a tank for over two years. One female was found to be bearing eggs in April this year, but I do not know if they hatched out.—Robert Gurney.

Introduction of the Large Copper Butterfly, *Chrysophanus rutilus*, in Norfolk.—An attempt has been made during the past summer to introduce the Large Copper Butterfly (*Chrysophanus rutilus*) on one or two of the Norfolk marshlands, on ground where it is justifiable to suppose that its extinct British form, *C. dispar*, may once have flown. The scheme was planned by the Nature Protection Committee, in collaboration with a few Entomologists, and Mr. John Cator, who has taken a keen personal interest himself in the scheme, very kindly allowed his marshes at Woodbastwick to be utilised for the experiment. Mr. E. B. Purefoy, who had successfully planted a colony of *C. rutilus* in Tipperary, Ireland, in 1914, undertook to carry the plan through, and, with Mr. Edelston of the Protection Committee, visited the Woodbastwick marshes last May, when he was shewn all the likely ground by Mr. Cator. A considerable

number of pupæ, in various consignments, were posted to Mr. Hunt, the headkeeper at Woodbastwick, and these were placed by him under specially arranged nets, stretched over wire frames, which had been prepared for the purpose, in certain spots on the marsh, the idea being to liberate the imagines in the centre of the most suitable ground. The first imago hatched on July 1st. During the whole month of July about 550 butterflies were liberated.

The marshes were visited on July 27th and 28th in bad weather, and only one male was noticed. A fair number of ova were found on Water-docks. It is probable that the bad weather had given the butterflies only a very poor chance, and that they had suffered from a lack of flowers earlier in the month. The marsh flowers were exceptionally late this year.

The ground was visited again a month later, and about 150 larvæ were counted, just about ready to retire into hybernation for the winter; they seemed healthy and promising, but there should have been far more. It is hoped that a further consignment of pupæ will be put down next year.

The original larvæ were collected in the marshes north of Berlin. The Nature Protection Committee intend to plant Wood Walton Fen in Huntingdonshire with Dutch *C. dispar* (*rutilus*). Holme Fen is immediately North of Wood Walton, and it was in this Fen that the last 5 British *C. dispar* were captured in 1847.—GERARD H. GURNEY.

A NEW NORFOLK BIRD.—Coue's Redpoll (*Acanthis hornemanni exilipes*) has, so far as I can make out, never been recorded from Norfolk, though it must occur in every large visitation of Mealy Redpolls. I obtained one (a female) in the big Redpoll year of 1910 which was taken among many Mealy Redpolls on the North Denes at Yarmouth on October 26th, just about the same date that Dr. W. Eagle Clarke obtained three in Fair Isle.

Last winter again there were a number of Mealy Redpolls in Norfolk and I received from Master R. L. Wathen another example of Coue's Redpoll (a male) obtained at Marsham on January 4th, 1926. It may be noted that one was recorded from Scarborough in December, 1925. This bird may be distinguished by the fine bill, paler upper parts and pure white rump from the ordinary Mealy Redpoll).—C. B. TICEHURST.

A New Bat for Suffolk.—About 6 years ago I saw at Lowestoft some bats which I did not know and which I provisionally named as the Serotine. I was attracted to them by their peculiar flight, rather low and flapping, and quite unlike that of the Noctule, which species however they resembled in size. They appeared about the same time every evening —so far as I remember about half an hour after sunset—and always took the same course to their hunting grounds—some high trees lining the Oulton road, and a haunt much frequented by Pipistrelles and Noctules. So far as I could ascertain, the home of these bats was some outhouses of a nearby house. After studying them on many evenings I managed to secure a bat which however turned out to be a Noctule, and when I shot at it I was not at all sure that it *was* the unknown one which I was searching for. Further attempts to obtain my unknown species failed and I wondered if after all I had been mistaken and had all the time been looking at Noctules, whose flight for some reason or another was not typical. It was therefore with very great interest that I received from Mr. F. Cook on October 3rd, 1926, a bat which had that morning been picked up in the Oulton road with a broken wing, and which I at once recognized as a veritable Serotine (*Vespertilio serotinus* Schreber). The distinguishing characters of this bat as opposed to the Noctule are the comparatively greater *breadth* of the wings, the *elongate tapering* tragus and the tail reaching *beyond* the inter-femoral membrane.

Though of very wide distribution on the continent—middle and South Europe across Asia to China, south to Persia and Kashmir—no British bat has, so far as is known, so limited a distribution in Great Britain. It occurs, and is abundant in some localities, between the Thames and the Channel, but west of Hampshire it is almost unknown and there are only three records of it north of the Thames—all in Essex (Coggeshall prior to 1863, Broomfield 1894, Pitsea 1906). This Lowestoft colony is then a very considerable extension of range of this species to the north and one can hardly suppose that it is unique, but that here and there there must occur other colonies and perhaps in Norfolk too. But Bats are hardly studied by anyone and this and other species are possibly commoner than is known.—C. B. Ticehurst.

BRITISH MUSEUM
26 JAN 27

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Ordinary Members proposed and seconded at any meeting of the Society are balloted for at the next meeting. The Annual Subscription is 10s., payable in advance on election, subsequent subscriptions becoming due on the last Tuesday in March annually. This subscription may be compounded for by a single payment of £8.

Ladies or Gentlemen distinguished for their attainments in Natural Science, or who have rendered valuable services to the Society, may be nominated by the General Committee as Honorary Members, and elected by a show of hands at the next meeting of the Society. Such Honorary Members have all the privileges of Ordinary Members.

NATURAL HISTORY.

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TRANSACTIONS

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NATURALISTS' SOCIETY

PRESENTED TO MEMBERS FOR

1926—27

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The Committee beg to direct the attention of authors of communications to the Society to the following Regulations which have been drawn up in order to accelerate the publication of the Transactions, and to utilise as widely and as fairly as possible the funds which the Society devotes to the publication of scientific researches :—

1.—Precedence will be given to papers dealing with local Natural History.

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4.—Proofs.—In general, a first proof and a revise of each paper will be sent to the author. If further proofs are required, owing to corrections or alterations for which the printer is not responsible, the expense of such proofs and corrections shall be charged against the author. All proofs must be returned without delay addressed to the Hon. Editor.

5.—Abstracts.—Authors are requested to hand to the Hon. Secretary abstracts of their Papers at the same time that they deposit their MSS.

6.—Separate Issue or Reprints.—An author requiring reprints of his paper must inform the Editor of the number of copies he will require. He will be charged for them by the printer, who will forward the copies to him when ready, shortly after the publication of the Transactions.

The Norfolk and Norwich Naturalists' Society has for its objects—

1. The practical study of Natural Science.

2. The protection, by its influence with landowners and others, of indigenous species requiring protection, and the circulation of information which may dispel prejudices leading to their destruction.

3. The discouragement of the practice of destroying the rarer species of birds that occasionally visit the County, and of exterminating rare plants in their native localities.

4. The record of facts and traditions connected with the habits, distribution, and former abundance or otherwise of animals and plants which have become extinct in the County ; and the use of all legitimate means to prevent the extermination of existing species, more especially those known to be diminishing in numbers.

5. The publication of Papers on Natural History contributed to the Society, especially such as relate to the County of Norfolk.

6. The facilitating of a friendly intercourse between local Naturalists by means of Meetings for the reading and discussion of papers and for the exhibition of specimens, supplemented by Field-meetings and Excursions, with a view of extending the study of Natural Science on a sound and systematic basis.

7. Any Member who, in the opinion of the Committee, contravenes the objects of the Society is liable to have his name erased from the List of Members.

TRANSACTIONS

OF THE

Norfolk and Norwich

NATURALISTS' SOCIETY

1926—27

VOL. XII.—Part III

NORWICH
Printed by A. E. Soman & Co.
December, 1927

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1926 Nash J. E., 27, Lansdowne Grove, Neasden, London, N.W. 10
1910 Nash J. T. C., M.D., D.P.H., Shirehall, Norwich
1922 Nevill Rev R. W., Old Catton Vicarage, Norwich
1926 Nevill Mrs. R. W. .. ..
1925 Neville R. J. N., M.P., Sloley Hall, Norfolk
1911 Newman L. F., St. Catherine's College, Cambridge
1893 Newton E. T., F.R.S., *Hon. Mem.*, H.M. Geological Survey Office, 28, Jermyn Street, London
1889 Nicholson W. A., *Hon. Mem.*, 5, Mill Hill Road, Norwich
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1926 Norfolk and Norwich Library, Norwich
1919 Norgate Philip, Swanington, Norfolk
1915 Norwich Public Library

Elected.

O

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1921 Offord Miss Georgina, "The Larks," Water Lane, Costessey
1914 Oliver Prof. F. W., F.R.S., *Hon. Mem.*, *V.P.*, University College, London, W.C. 1
1924 Orgill Miss M. A., Garboldisham, Diss

P

1889 Page G. W., Walsingham, Norfolk
1919 Pain Percy, Dersingham, King's Lynn
1913 Paine Rev. N. W., Great Melton Rectory, Norfolk
1919 *Palmer Mrs. P. Hurry, "Red Roofs," North Drive, Great Yarmouth
1926 Pank A. H., Bedford Street, Norwich
1912 Parker H., 10, Aspland Road, Norwich
1925 Parker Miss Molly Hyde, Smeetham Hall, Sudbury, Suffolk
1921 Parker R. E., Easton, Norwich
1883 *Parkin Thomas, M.A., F.Z.S., High Wickham, Hastings
1873 Partridge Rev. W. H., M.A., "Breccles", Sandown, I. of W.
1923 Partridge F. H., St. Helier, Hunstanton
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1911 *Payler Donald, Castle Museum, Norwich
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1923 Peed John, Aylsham
1926 Percy Lord William, Catfield Hall, Norwich
1903 Petre Col. B , Westwick Hall, Norfolk
1925 Petrie Mrs , The Dower Hou e, Heydon, Norwich
1926 Phillippo G., 7, St. Philip's Road, Norwich
1925 Pilch R. G., 45, Grosvenor Road, Norwich
1923 Pope Dr. G. Stevens, Heigham Hall, Norwich
1880 Preston A. W., F.R.Met.Soc., Christ Church Lodge, Norwich
1919 Preston Sir E., Bart., Beeston Hall, Norwich
1900 Preston F., Thorpe Mansions, Norwich
1913 Purdy T. W., Woodgate, Aylsham
1925 Purnell Mrs. Ralph, 9, The Crescent, Norwich
1925 Purnell Ralph, 9, The Crescent, Norwich
1887 Pycraft W. P., A.L.S., F.Z.S., British Museum (Natural History), London, S.W.

R

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1924 Richmond H. W., F.R.S., King's College, Cambridge
1925 Ringrose B., Wilford Rise, Bromeswell Heath, Woodbridge
1924 Rippingall Neale F., Crabbe, Weighton S.O., Norfolk
1911 Rising A. P., The Manor House, Ormesby, Great Yarmouth
1908 Riviere B. B., F.R.C.S., F.Z.S., M.B.O.U., Hill House, Saxlingham, Norwich
1869 O.M. Robinson H. S., Eaton, Norwich
1908 Rogers Commander F. S., R.N., Ingham New Hall, Norwich
1909 Rogers Rev. Henry, Colishall H l , N rwich
1884 *Rosebery The Right Hon. the Earl of, K.G., 38, Berkeley Square, W. 1.
1908 *Rothermere Rt. Hon. Lord, Hemsted Park, Cranbrook, Kent
1897 *Rothschild Rt. Hon. Lord, F.Z.S., Tring, Herts.
1922 Rounce G. H., The Pines, Park R a l, Cr mer
1879 Royal Microscopical Society, President of the, *Hon. Mem.*, 20, Hanover Square, W.
1918 Rudd A. J., F.Z.S., Queen Street, Norwich

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S

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1925 Sexton K. F., 156, Newmarket Road, Norwich
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1878 Taylor Shephard T., M.B., The Mount, Edgefield, Melton Constable
1921 Thain D., West Somerton, Norfolk
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1913 Tomes Sir Chas., LL.D., F.R.S., Mannington Hall, Norfolk
1923 Tomes Lady, Mannington Hall, Norfolk
1923 Torbell C. J., 11, Essex Street, Norwich
1910 Tracy N. 3 King Street, King's Lynn
1925 Tucker B. W., 3, Park Crescent, Oxford
1906 Turner Miss E. L., F.Z.S., H.M.B.O.U., 13, Storey's Way, Cambridge

U

1923 Upcher Rev. E. C. S., Great Dunham Rectory, Norfolk
1921 Upcher H. E. S., The Gables, Upper Sheringham

V

1880 Vaughan Matthew, The Limes, Marlborough
1917 Vincent James, Hickling, Norfolk

W

1921 Wallis Rev. M. C., The Vicarage, St. Faiths
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1923 Waterfield Miss, Attlebridge, Norfolk
1923 Waterfield Miss Penelope, Attlebridge, Norfolk
1926 Wemys Major, " Bryn coed," Wroxham
1927 Wemys Mrs. ,, ,,
1923 Wenn Mrs., Ingham, Norfolk
1923 Wenn Miss, Ingham, Norfolk
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1922 Willett W. L., The Rosary, Metfield, Kent
1913 Williams Miss Margaret, 28, The Close, Norwich
1909 Witherby H. F., M.B.E., F.Z.S., 326, High Holborn, W.C.
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1922 Wortley Francis, " Congham," Sheringham
1924 Wright B. D. Z., Hoveton St. John, Norwich
1920 Wyllys Hugh, " Shrublands," Southtown, Great Yarmouth

Y

1923 Young The Right Honble. Sir E. Hilton, D.S.O., P.C., M.P., 174, Buckingham Palace Road, S.W.
1915 Yarmouth Free Library, The, Great Yarmouth

TOTAL

Honorary Members	... ...	7
Life ,,	... ...	34
Ordinary ,,	... ...	382
		423

JUNIOR BRANCH

Barclay Miss H., Tittleshall Rectory, King's Lynn
Barclay Miss P., The Warren, Cromer
Barclay Peter, The Warren, Cromer
Barclay Thomas, The Warren, Cromer
Barrett Reginald, 12, Beatrice Road, Thorpe Hamlet
Barry Miss E., Great Witchingham Hall, Norwich
Barry Miss N., Great Witchingham Hall, Norwich
Chamberlain Miss J., Witton Rectory, Norwich
Citters Miss W. van, Wroxham, Norwich
Cole Miss R., Sprowston, Norwich
Cole A. L. F., Sprowston, Norwich
Ferrier Miss J. M., Hemsby Hall, Great Yarmouth
Gurney O. R., Ingham Old Hall, Norwich
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Lascelles Miss S., Swanton Novers, Melton Constable
Long Miss E., 31, Surrey Street, Norwich
Morrison Miss E., Barmer Hall, King's Lynn
Morse Miss R., Earlham Lodge, Norwich
Parker Miss P., Marlingford, Norwich
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Upcher Miss R., Dunham Rectory, King's Lynn
Walter Miss E., Drayton Old House, Norwich
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Waterfield Miss Penelope, Attlebridge, Norwich
Waterfield, Miss Philida, Attlebridge, Norwich
Wathen R., Bolwick, Marsham, Norwich
Wathen M., Bolwick, Marsham, Norwich
Winch Miss D., Swanington Court, Norwich

The Treasurer in Account with the Norfolk and Norwich Naturalists' Society, Year Ending April, 1927

I. GENERAL ACCOUNT

1926–27. Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance on Deposit	67	9	10	By "Transactions," vol. xii., part ii.	131	4	6
,, ,, Current Account	38	13	6	,, Norfolk & Norwich Library	6	6	0
,, Subscriptions	163	3	0	,, Printing	8	2	6
,, Sale of "Transactions"	0	17	6	,, Postages, etc.	11	6	3
,, Sale of "Flora of Norfolk"	0	6	0	,, Book-binding	8	12	10
,, Special Publication Fund	16	13	0	,, Expenses of Meetings	4	17	2
,, Pavment by W. B. P. F.	10	0	0	,, Fire Insurance	0	13	6
,, Interest on War Stock	5	5	4	,, Balance on Current a c	13	15	7
,, Interest on Deposit a/c	1	16	4	,, ,, Deposit a c	119	6	2
	£304	4	6		£304	4	6

Examined and found Correct,
W. A. NICHOLSON,
April 25, 1927

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II. SPECIAL PUBLICATION FUND

1926-27.	£	s.	d.		£	s.	d.
To Donations—				Transferred to General Account	16	13	0
Dr. E. H. Hankin	9	6	6				
Dr. B. G. Sumpter	1	1	0				
Sir Eustace Gurney	1	1	0				
Edward Wild	1	0	0				
Col. E. A. Bulwer	1	0	0				
R. Gurney	1	0	0				
C. Silcock	0	10	0				
Sums under 10s.	1	14	6				
	£16	13	0		£16	13	0

III. LIFE MEMBERSHIP FUND

1926-27.	£	s.	d.		£	s.	d.
To Balance in Savings Bank, April, 1927	53	7	8	By Interest transferred to General Account	5	5	4
,, One Life Member	8	0	0				
,, Interest on Bank Account	1	6	6				
,, Interest on War Stock	5	5	4	,, Balance in Savings Bank	62	14	2
	£67	19	6		£67	19	6

Investments and Assets as on April 19th, 1927

	£	s.	d.
£105 6s. 10d. 5 per cent. War Stock 1929-47, at cost	100	0	0
64 War Savings Certificates, dated 24.1.19	64	0	0
31 War Savings Certificates, dated 17.7.23, at cost	24	16	0
Balance in Savings Bank	62	14	2
	£251	10	2

ADDRESS

Read by the President, E. Hanbury Hankin, M.A., Sc.D., *to the members of the Norfolk and Norwich Naturalists' Society, at their Fifty-Eighth Annual Meeting, held at the Norwich Castle Museum, on April 26th,* 1927.

Ladies and Gentlemen,

The membership of the Society still continues to increase, twenty-five new members having been elected during the year, and we now have well over four hundred members.

At our monthly meetings some very interesting papers have been read, one of these being a lantern lecture on the birds of the Broadland District by Mr. Jim Vincent of Hickling. The Bird Watchers employed by the Society were present at this lecture.

The Society has lost by death two old and valued members, Sir Digby Pigott and Mr. Frederick Long. Obituary notices will appear in the next issue of our Transactions.

It is greatly to be regretted that the Committee has been unable to find anyone willing to accept the duties of Excursion Secretary. These excursions are greatly appreciated, but unless someone will come forward and undertake their organization, they cannot be carried through.

For my Address I have chosen an astronomical subject ;

THE PROBLEM OF MARS

Changes, partly seasonal, in colour and shape of certain markings on the planet Mars appear to leave no room for doubt that some form of life is there present. We know so little as to what are the fundamental and necessary characters of living beings that there is but little justification for using the analogy of life on earth in forming conceptions of the possible forms of life on Mars. From this point of view many statements made by astronomers about Martian life are open to criticism.

For instance, Pickering, one of the most distinguished and persevering of the observers of Mars, having satisfied himself that the Martian atmosphere contains oxygen up to 15 per cent. of our own, goes on to say " It is therefore clear that animal

life, which had developed increased lung capacity, may readily exist on Mars." This may be admitted, but what is open to criticism is his apparent inference that animals on Mars, if animals there exist, have lungs. We have lungs because we are descended from fishes whose swim-bladder has gradually been modified to subserve terrestrial respiration. The great majority of air-breathing organisms on the earth, apart from those of microscopic size, are provided with minute branching tubes that carry oxygen directly to the tissues. It is just as possible that Martian animals, if such exist and if air-breathing, are provided with tracheæ or some other aerating mechanism rather than with anything resembling lungs.

But what right has Pickering, Lowell, and other astronomers to assert that animal life exists on Mars? If the facts of observation justify us in believing that intelligent life is present on that planet, why should not this intelligence reside in living beings having locomotive powers and sense organs but depending on chlorophyll for their nutrition? On the earth the larger forms of life fall naturally into two classes, those that take liquid and gaseous food that we know as vegetables and those that, broadly speaking, eat solid food and that we know as animals. If we knew the secrets of the metabolism of the smaller forms of terrestrial life, it is possible that we should find among them some differing from animals and vegetables as much as animals and vegetables do from each other. How can we venture to assert that living beings on Mars must be of such a nature that they can be classified in the same way? What right have we to argue from terrestrial analogy that intelligent beings on Mars can only be found among parasites on the vegetable world provided with a mouth through which they take in solid food?

If Martians have the power of reproduction—and if they use it—it seems inevitable that they must compete with one another for the physical necessaries of life such as water, air and space. But we have no more right to assume that their competition involves preying on one another than we have to assume that they have sexual reproduction.

Life as we know it on the earth is originally and naturally immortal. This is the case at the present day with microscopic organisms consisting of single cells which, as they grow older,

do not die but divide forming new individuals. The higher plants and animals consist of colonies of cells, of which cells only a few retain primitive immortality and develop into offspring. The others, which we recognize as the body of the individual plant or animal, are condemned by nature to death when they have performed their function of guarding and nourishing the germ cells. Thus the body of an animal corresponds to the cyst of an amœba which is likewise destined to perish when it has performed its function of guarding the germ cells till they are ready to carry on an independent life. This rule is universal among the more efficient living beings on earth, but what right have we to assume that this complicated device exists with the inhabitants of Mars? It might be answered that probably life of a high degree of complexity is present on Mars and that such life could not have come into existence unless some perished while others, the fittest, survived. To this it may be replied that if individuals on Mars are immortal they may be constantly improving by elimination of the less fit parts of their bodies. If this were so each individual would be the repository of experience which would be maintained and might be used far more efficiently than can be the case on earth where, at frequent intervals, acquired experience, taking the form of instincts, has to be squeezed into and transmitted through the germ cells. We know so little of the fundamental properties of living matter that, in the present state of our knowledge, we are unable to exclude this possibility. Neither can we, on *a priori* grounds, exclude the idea that Martian life exists in the form of a single gigantic and immortal vegetable whose strands we see encircling the planet as the so-called canals. We have no right to condemn such a suggestion because it strikes us as highly improbable. We must discard it on the safer ground that it seems to be incompatible with certain known facts of observation about to be described.

It is asserted by astronomers that not only life but also intelligence of a high degree exists on Mars. Foremost among the observers of Mars is the American astronomer Lowell. It is unfortunate that he has expressed his opinions on this point with a dogmatism of a kind likely to arouse opposition. In dealing with a skilled observer it is necessary to distinguish

between what he sees and what he thinks about what he sees. We must not allow our distrust of his sensational conclusions and his obviously too confident use of terrestrial analogy to lead us to disregard the many remarkable facts he has discovered. Let us first quote some of his statements. He says that the observer of Mars "stands confronted with the workings of an intelligence akin to and therefore appealing to his own." . . . . "Not only does one species possess the planet, but even its subdivisions must labour harmoniously to a common aim. Nations must have sunk their local patriotism in a wider breadth of view." . . . . "The first thing that is forced on us in conclusion is the necessarily intelligent and non-bellicose character of the community which could act thus as a unit throughout its globe." Referring to the Martian summer being longer than our own, he says "This lengthening of the period of reproduction cannot but have an elevating effect upon the organism akin to the prolongation of childhood pointed out by John Fiske as playing so important a part in the evolution of the highest animals." Perhaps the most singular of his conclusions is this, "In our exposition of what we have gleaned about Mars, we have been careful to indulge in no speculation."

On the earth the evolution of a high degree of intelligence is but an affair of yesterday. It is by singular and puzzling chances that that somewhat grotesque product of evolution the anthropoid ape has evolved into *Homo sapiens*. Man stands alone among the myriads of species of living beings that exist or that have existed on the earth in having a high degree of intelligence. Thus on the earth the production of intelligence is a rare phenomenon. If there is an analogy between Martian and terrestrial life, as is assumed by Lowell and other astronomers, then we must regard the idea of Martian intelligence with a very great degree of scepticism and, before accepting it, must demand the most rigorous and exhaustive proofs.

If, on the other hand, the nature of living beings on the planet Mars is entirely different from what we are acquainted with on our globe, if from their nature they are endowed with a capacity for storing and using experience of a kind entirely different from that possessed by terrestrial life, and if the

Martians are engaged in a common fight against the conditions of their environment rather than in devising means of killing and eating one another, then the idea of Martian intelligence may appear less improbable, while, at the same time, we are the less justified in using terrestrial analogy in guiding our beliefs.

Having thus emphasized the need for caution in forming any opinion as to the nature of life on Mars, let us proceed to review briefly the known facts of the case.

Discoveries made in recent years indicate that the conditions on Mars are not so incompatible with life of the terrestrial pattern as was once believed. Owing to its great distance from the sun, Mars must receive much less heat than does the earth. It was therefore inferred that its temperature must always be far below that of the freezing point of water. The polar caps of Mars, which melt in the Martian spring, were explained by the supposition that they consisted of frozen carbonic acid. But this belief overlooked the effect of the scarcity of water on Mars. Lowell has calculated that Mars possesses 189,000 times less water than does the earth. Its atmosphere, in consequence, is much drier than ours. Water vapour dissolved in the air has a great power of stopping solar heat rays. Without this protecting vapour the earth, where exposed to sunshine, would be very much hotter than it is. Dryness of the Martian atmosphere is consequently a condition that permits heat from the sun to reach the surface of that planet. Hence it is not very surprising that actual measurements, by delicate thermopiles, have yielded reasons for believing that the temperature of the brightly illuminated surface of Mars is not unlike that of a cool bright day on the earth with temperature ranging from 45° to 65° F. So delicate was the apparatus employed in this research by Coblentz and Lampland* that it was possible to measure the radiation not only of the planet as a whole but also of its different parts. It was found, for instance, that the part illuminated by the afternoon sun is warmer than that exposed to the morning sun, and that the dark areas (which are supposed to be covered with vegetation) are warmer than the desert areas.

**Publications of the Astronomical Society of the Pacific*, Vol. XXXVI., October, 1924, p. 273.

It used to be thought that the atmosphere of Mars is extremely tenuous. The force of gravity on that planet is only about 3/8 of that on the earth. This lesser force of gravity was taken to imply that Mars has less power of holding and attracting its atmosphere than has the earth. Hence it was supposed that much of its original atmosphere had gradually leaked away into space. Mars was described by Lowell as having lost most of its water in this way and he imagined that its inhabitants were hard put to it to economize the remaining supplies and were facing the prospect of eventual death from thirst. But, according to Pickering, the atmospheric pressure in Mars cannot be widely different from that on the earth. It may even, he says, be denser. One reason for this belief is that clouds on Mars have occasionally been seen rising to the enormous height of 50 to 55 miles above the surface, a phenomenon that affords a proof of the presence of a supporting atmosphere of large extent.

Let us now consider the facts of observation that are supposed to justify the belief that some form of life is present in Mars.

Parts of the planet are of pale reddish to ochre-yellow colour, the tint varying from time to time. These areas, which occupy about 3/5 of the surface are supposed to be deserts.

Other parts of the planet are of darker tint and were once supposed to be seas. They are now believed to be more or less dry land, probably lying at a lower level than the deserts. They show colour changes which suggest that they support some kind of vegetation. In the Martian spring these areas have either a pale green or a greyish colour. During the summer the tint deepens to darker green, bluish-green or blue. In the autumn the colour changes to brown, yellow, or grey. Lowell, believing that the green colour is due to vegetation, explains the blueness as due to the effect of haze, such as sometimes on the earth causes vegetation on distant mountains to assume a bluish tint. Pickering, on the other hand, adduces facts that do not agree with this explanation. A dark area known as the *Mare Acidalium* first appears as a greyish marking in the spring as the north polar cap melts. Later it turns blue and retains this colour for several months. Another dark area, the *Syrtis major*, he says, may turn blue but it never

retains this colour for more than a few days at a time. He denies that the blue colour is due to water and asserts that it is due to some form of vegetation.

These curious observations at once suggest a number of questions. For instance, how often does the *Syrtis major* turn blue? Does this happen once or several times during the Martian summer? As regards the autumnal colour-changes to either brown, yellow, or grey, which, according to Pickering, suggest different kinds of vegetation, does each dark area always assume the same autumnal colour? Or does the same area take on different autumnal tints in different seasons? Are the observers of Mars on the look-out for evidence of rotation of crops, which, if ever it were firmly proved, might give a reason for suspecting intelligent activity?

The change of seasons is far more abrupt on Mars than with us. The turning brown in the autumn of a particular area is described by Pickering as advancing at the rate of three hundred miles a day.

That the above-described colour changes are in fact due to vegetable life is further made probable by their connexion with the melting of the polar caps. It is only as the snow vanishes that the green colour appears and spreads. It seems that on Mars it is the supply of water rather than the warmth from sunshine that determines the coming of spring, for the green colour appears first near the margin of the polar cap, as the snow begins to melt, and spreads thence towards the equator.

The possibility has been suggested that some inorganic substance is present on Mars that has the property of changing colour according to the amount of moisture it contains. In this way the connexion between the colour changes and the melting of the polar caps might be explained without recourse to the hypothesis of the presence of life. This possibility appears to be made improbable by the fact that the extent and shape of the dark areas may vary greatly in different years. For instance, Antoniadi has published drawings of the dark area known as the *Solis lacus* as seen by him in 1924 and again in 1926. On the latter occasion it had altered in shape and extended in a northerly direction over an area nearly as large as France. The further hypothesis that moisture-bearing

winds might travel in different directions in different years seems insufficient to explain the facts, as on each of the two occasions mentioned the *Solis lacus* was surrounded by other dark areas that exhibited no conspicuous changes.

Other dark areas appear to take up different positions in different years or to vanish entirely and reappear after a longer or shorter interval. According to Pickering the north end of *Syrtis major* may shift laterally in position by as much as 183 miles. He is of opinion that the *Syrtis* is a swamp that is flooded by the melting of the two polar caps in turn in each Martian year. The shifting in position of a swamp appears to need some further elucidation. The usually prominent feature known as the *Fastigium Aryn*, from which Martian longitudes are measured, is sometimes invisible and also, according to Pickering, is liable to change its position.

We now pass on to the vexed question of the celebrated canals on Mars. In the first place it may be stated that those who deny the presence of band-like or linear markings on the surface of the planet show themselves unacquainted with the evidence that has now accumulated. There can be no doubt whatever that such markings are visible to all competent observers when the planet is viewed under suitable conditions. Pickering says: "Given the proper conditions, almost anyone can see the coarser canals at the first glance, and after five or ten minutes' study will see most of the fainter ones."* The needful conditions however seem only to exist at certain observatories. Pickering was unable to see the canals at Cambridge in the United States. Antoniadi, whose observatory is situated at Meudon in France, is quoted as saying; "We affirm in the most categorical fashion that no intricate system of fine lines exists on Mars." It may be suggested that it would have been safer for him to say that he himself had failed to see such lines. Very clear evidence exists that observations made at his observatories are less satisfactory than those made by many other astronomers.†

**Publications of the Astronomical Society of the Pacific*, Vol. XXX., October, 1918, p. 299.

† Compare, for instance, his drawings of the region of the *Solis lacus* with that made by Pickering ("Monthly Report on Mars" in *Popular Astronomy*, Vol. XXXIV." p. 149). See also E. C. Slipher, *Popular Astronomy*, Vol. XXXII., No. 9, November, 1924, p. 2. "Observations of Mars in 1924 at the Lowell Observatory."

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NATURAL
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Fig. 1
Pickering 358 A

Fig. 2
Hamilton 1 A

Fig. 5
Pickering 60 B

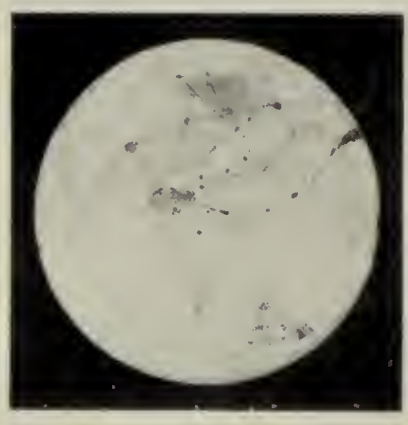


Fig. 6
Hamilton 67 B

Fig. 9
Pickering 118 C

Fig. 10
Hamilton 122 C

Examples of drawings of Mars by different observers.
From Popular Astronomy, Vol. 34.

Pickering has performed a great service by forming an association of observers of Mars who, from different parts of the world including Arizona, Japan and Ceylon, have sent him numerous drawings of the planet as seen by them under different aspects. He has reproduced a number of these drawings in his Reports on Mars published in several volumes of *Popular Astronomy*. Some of these from Vol. XXXIV. are shown in Plate XX. The similarity of the drawings made by different observers thus shown is striking. The drawings by Trumpler are of interest in that he had made no previous study of the topography of Mars; but yet his drawings closely resemble those made by other observers and also include some small canals that had been overlooked by others but that had been seen by Professor Lowell many years previously. Referring again to Plate XX, it may be noted that certain canals which are seen by Pickering as bands of appreciable width, appear to Hamilton as fine lines. This differing appearance of the canals to different observers is rather puzzling. On this point Pickering says :—" When the writer erected the first dome and 18-inch telescope at the Lowell Observatory in 1894, he and Professor Douglas saw the canals exactly as they see them now, as grey markings of appreciable breadth, while Professor Lowell saw them always as fine lines. It is clearly then a question of personality."*

Scepticism as to the existence of the canals has been supposed to be justified by the asserted impossibility of photographing them. But they are shown, though imperfectly, in some of the more recent photographs. Great technical difficulties are met with in obtaining such photographs. Special colour filters, specially prepared plates, a short exposure of from $1\frac{1}{2}$ to $2\frac{1}{2}$ seconds, are required. Much of the detail thus obtained is lost when the photographs are reproduced for a magazine article. But it is movements of the terrestrial atmosphere that are the chief obstacle to securing sharpness of delineation of such details as the Martian canals. Hence large numbers of photographs have to be taken in the hope of catching the planet at moments of best definition. Examples of such photographs are shown in Plate XXI. They were taken in connection

*" Monthly Report on Mars," *Popular Astronomy*, Vol. XXIII., p. 220.

with an appearance of haze that obscured the *Syrtis major* in the mornings and evenings during a couple of months. In this illustration, between the photographs, a drawing of the planet on a slightly larger scale is inserted. Comparing this drawing to the face of a clock, at the position corresponding to 2 o'clock, a whitish area is visible which hides all except the northern end (the lowest in the photograph) of the *Syrtis major*. The north polar cap is shown on the lower margin of the drawing. These features, and also an indication of some of the more conspicuous canals, can be made out on the photographs.*

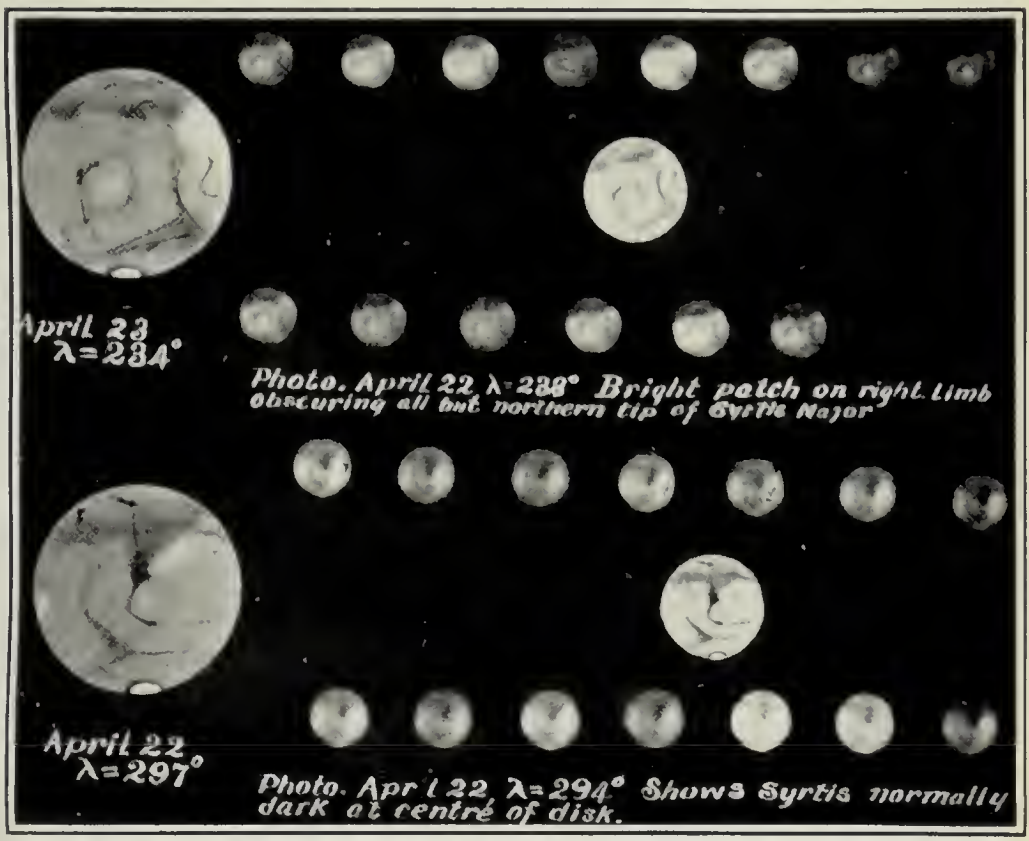
Admitting that the canals exist, the next question to interest us is their possible nature.

Whether, as asserted by Lowell, they are from two to thirty miles wide, or whether, as believed by Pickering, their width varies from 100 to 250 miles, there is no room for doubt that what is seen is not irrigation channels of water of such sizes

It has been suggested that what is seen is a belt of vegetation bordering a channel of reasonable size along which flows water derived from the polar snows. Against this idea may be pointed out the fact that sometimes the larger canals cross one another either at right angles or at smaller angles as if they were entirely independent structures. Sometimes these intersections are marked by small dark spots, known as oases, whose size is estimated by Lowell as being from fifteen to one hundred miles in diameter. They fade out of sight on the approach of the Martian winter at the same time as do the canals that enter them. During this process occasionally the centre of the oasis fades first. Lowell adduces their circular shape as a proof that they are the product of intelligent action, a deduction, it may be suggested, of very questionable value.

The canals often run in a straight line for such distances as 2,000 to 2,500 miles. This straightness has been adduced by Lowell as a proof that they are due to an intelligence "akin to our own." This argument is the reverse of conclusive, as canals designed by human intelligence would pay some attention to the

*E. C. Slipher, "Photographing the planets with special reference to Mars," *Publications of the Astronomical Society of the Pacific*, No. 193, June, 1921, p. 1, and "Obscuration of the Martian Syrtis Major," *Popular Astronomy*, Vol. XXIX., No. 2, February, 1921, p. 1.


April 23
λ=234°
Photo. April 22 λ=238° Bright patch on right limb obscuring all but northern tip of Syrtis Major
April 22
λ=297°
Photo. April 22 λ=294° Shows Syrtis normally dark at centre of disk.

Photographs of Mars by Slipher.
Enlarged drawings of the Planet are inserted for comparison.

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contours of the country. Though observations make it probable that no mountains and no elevations of more than two or three thousand feet exist on the desert surfaces of Mars, it is difficult to believe that these areas are so absolutely flat as to justify the straightness of irrigation channels running across them. Lowell asserts that the dark areas of the southern hemisphere are at a lower level than the deserts. According to Pickering, this difference of level may amount to as much as 8,100 feet.* Nevertheless, certain canals run through the dark areas and up hill on to the deserts in the same straight line as if there was no obstruction to their course. No doubt the straightness of the canals *may* be the result of intelligent action, but the safer inference would be that the phenomena of Mars are quite inexplicable at the present time.

One curious observation may now be mentioned which, if substantiated, may be regarded as affording a slight presumption that the canals are indications of an irrigation system. Some of the canals occasionally appear to be double. On careful examination the canal is seen to consist of two faint lines running parallel to each other and lying at a distance from each other of from 75 to 200 miles. Out of 437 canals observed by Lowell, 51 have been seen double. According to Pickering this doubling has been seen occasionally by nearly every observer. Of such twinned canals one member is occasionally weaker than the other. It is always the same one of the pair that weakens with two exceptions. These are of twinned canals having approximately a north and south course. In each of these instances, one member of the pair is fainter when the canal is fed by melting of the north polar cap and the other when the canal is fed from the south polar cap.†

On the irrigation theory an explanation may be offered, or rather a curious deduction may be drawn, from this anomaly. If, in a tropical country, irrigation without drainage is continued for a long time, then, as water evaporates from the irrigated surface, the salts contained in it are left behind. These gradually accumulate in the soil, at length rendering it sterile. Hence irrigation to be successful must be combined with

*"Monthly Report on Mars, No. 5," *Popular Astronomy, Vol.* XXII., p.295.

†*Nature*, April 27th, 1909, p. 260.

drainage. The alternate weakening of each member of the twinned canals thus suggests that, of the pair, one is used for irrigation and the other for drainage and that, as the source of their water changes, they reverse these functions. Obviously this suggestion is not one on which much weight can be laid in the present state of our knowledge.

A reference to salts dissolved in the water on Mars occurs in another connection. Lowell described white spots as occasionally appearing on the desert areas of Mars. He satisfied himself that they were not due to cloud. They last for weeks or even months. They occur chiefly in the north tropic belt and the most striking spots are found to the west of large dark areas. Lowell thought they were deposits of hoar frost. But since Lowell's time, evidence has accumulated that the surface temperature of Mars, away from the poles and in summer, is far above what would permit hoar frost to persist for so long. In reply to a question from me, Professor Slipher, the present Director of the Lowell Observatory, informs me, with commendable caution, that the idea that these spots might be deposits of salts left by the evaporation of water has been considered and that this idea, as an explanation, "would probably now seem to be more satisfactory than some years ago." In India the evaporation of water sufficient to make a visible deposit—the so-called "reh" soil—is a matter of months or years. But the white spots on Mars seem to appear suddenly. It is in accordance with mundane analogy that the water in a canal should be at a higher level than the land it is about to irrigate. Are we then to imagine that a canal has burst its banks and flooded an area of several hundred miles in diameter and that the water was so impregnated with salts that, at once, on its evaporation, a visible crystalline deposit was formed? Or was the flood a voluntary excretion of some waste product? Is an area on which a white spot has developed immune from the appearance of white spots in future, and if so, for how long? One infers from Lowell's description that these white spots disappear somewhat suddenly. Why do they disappear if they are alkali salts? Are they blown away by wind or are they covered with desert dust? It seems probable that many years of observation will be needed before we can expect answers to even such simple questions.

Pickering has made various suggestions as to the possible nature of Martian canals that do very much credit to his imagination.

The great difficulty in accepting the view that the canals contain irrigation channels is the enormous power that would be needed to pump water along them. It has been estimated at the rather fantastic figure of 2,500,000,000 horse power.* Pickering attempts to get round this difficulty by suggesting that the transport of water on Mars is by aerial routes partly along the course of what we see as canals. He considers that the Martian canals are of two kinds: (1) Temporary, which never turn green and which are due to the effect of dampness changing the colour of the soil; and (2) Canals, which in the summer season turn green and which may be regarded as due to vegetation.

For instance, the canal *Amenthes*, which had disappeared, in 1911, reappeared in 1921. It was seen on a particular occasion but "two hours later," he says, "on this same date, when on the central meridian, it could not be found although carefully looked for. This illustrates how ephemeral even well-marked tropical canals may sometimes be. No Martian clouds were visible in this place at this time. This observation tends to confirm our belief that some of the Martian canals are at times merely shower tracks which under a hot tropical sun dry up."†

He lays stress on the fact that in the terrestrial tropics, a shower having sharply defined limits at either side may proceed for several miles in a straight line. The genesis of such showers is well understood by meteorologists, and it may be confidently asserted that there would be very great difficulty in understanding how a shower could travel for a thousand miles or more on the planet Mars unless some unknown factors are at work there quite unlike anything known on earth.

The most singular, and perhaps the most attractive of Pickering's suggestions is based on his discovery of two broad greyish bands each running in a NS direction from near the

* C. F. Horsden in *The Riddle of Mars the Planet.*

† *Popular Astronomy*, Vol. XXXIII., p. 434.

polar cap to the southern dark areas.* He has seen them on three successive oppositions of the planet. He describes them as lasting about a month and varying rapidly in size, widening in one case to 1,200 miles. He says that the band bordering the melting polar cap, which is believed to be of water, was narrowest when following, i.e., to the west of the beginning of each of these bands, as if the latter drained the former of its water. He regards these bands as indicating a transference of water by an aerial route and also as a proof of intelligent activity.

He has also made the suggestion that rain may be caused to fall where it is wanted on Mars by the discharge of electrons. On the earth we have insects, bacteria, and protozoa that give out light, animals that give out heat, fishes such as the torpedo that give out electric shocks. Is it beyond the possibilities of nature for Martian vegetables to emit electrons, or must Pickering's supposed electrons be due to machinery worked by intelligent beings?

Lastly, we may mention Pickering's assertion that certain of the canals have been seen to shift laterally. Of two canals, *Gigas* and *Tartarus*, he says that they "apparently travelled some three hundred miles across country in about three weeks, that is, at a speed of fifteen miles a day. In that time they traversed their full breath." An attempt has been made to explain such apparent shifts by the assertion that these were double canals of which one member was seen at one time and the other member at another time. Pickering's answer to this criticism seems convincing to the non-expert, but I am not aware whether other astronomers accept his views on this point. (*Popular Astronomy*, Vol. XXIII., p. 227.)

* "Monthly Report on Mars, No. 11," *Popular Astronomy*, Vol. XXIV., p. 569.

II

A PORTUGUESE SAND DUNE

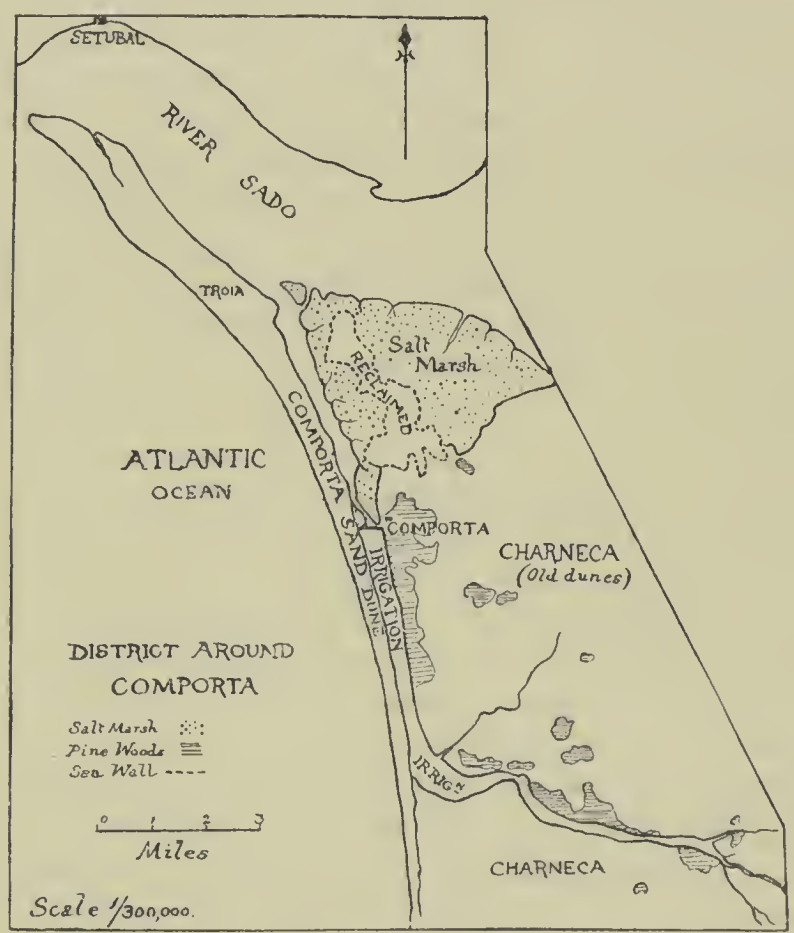
By F. W. Oliver, F.R.S.

On English Sand Dunes

Sandhills which go by the name of *dunes* are distinguished by the fact that they are created and moulded by the wind, also destroyed by the same agency. In the case of maritime dunes the materials of which they are composed have been blown by onshore winds from the foreshore to a higher level where they are out of reach of ordinary spring tides. The wind is the active agent of transport, whilst the plants which settle on the dunes, or which may even have been present on the terrace of assembly or beach prior to their appearance, tend to collect and hold the sand. This they do in the main by sheltering the surface from the ruder winds, though this stabilising action is doubtless assisted by the diminished evaporation from the surface where the shadows of the plant fall. Later, as humus accumulates through the disintegration of the pioneer plant covering, this added matter tends to hold the sand particles together, to promote chemical action, and at the same time to increase the water capacity of the soil. Plants in this relation are sometimes called "sand binders," and in a general way the term is justified. But the binding depends on the causes just outlined and has no direct connection with the fact that the sand is penetrated everywhere by a plexus of runners and rhizomes. It is the surface which is moved, and this subterranean equipment of the plants is only important in that it enables the sheltering shoots and foliage constantly to emerge at fresh points.

On English sand dunes the first vegetation is especially marram and other grasses, and with further piling up of sand these plants push through and give the surface a partial protection. For at this stage bare sand is visible between the haulms of the grasses, and this sand is stabilised only in so far as the plants act as a wind break. Where plentiful supplies of sand are available the height of the dune will go on rising until the exposure to windage is such that the amount of sand blown away balances that which is brought.

Meanwhile other colonists find their way into the relatively stabilised dune, perennial plants with deep rooting habit, such as Erodium, *Senecio Jacobaea*, *Carex arenaria*, and many others. Later, mosses and lichens arrive, often covering the surface very completely, whilst a further feature of most English sand dunes is the settlement of small annual plants, the ephemerals, plants which complete their life histories in



TEXT-FIG. 1. Map of the Comporta district, simplified from a map privately printed. The River Sado, to the south of which Comporta lies, is about 30 miles south of Lisbon.

early spring whilst surface moisture is still available. These, which include forms like *Draba verna*, *Saxifraga tridactylites*, *Cerastium semidecandrum*, etc., constitute a further element of protection, whilst their bodies on dying add to the humus of the soil.

With the increase of humus the dune soil becomes acid, a change which is emphasised by the gradual leaching out

of carbonate of lime derived from broken shell fragments blown up with the sand from the shore. Lime-loving plants are especially characteristic of the earlier, non-acid stage of the dune.

As regards the dimensions of the grains of sand on English dunes, the following figures, being the average of several determinations from the Blakeney Point system, may serve as an example (table, p. 283, last column).

The Comporta Sand Dune

The subject of the present account is the Comporta sand dune, a mound of sand stretching along the Atlantic shore of Portugal some thirty miles, from Cape Sines to the Bay of Setubal, where the dune ends freely as a headland in the estuary of the Sado, protecting on its east a large area of salt marshes from the Atlantic Ocean. The width of the dune varies from a half to two-thirds of a mile, and its height is from 70 to 80 feet. It consists of a coarse quartz sand, and its colour is a glistening white. Our dune runs from south to north. It slopes up gently from the sea, culminating first in an outer ridge. (A, text fig. 2.)

Text-Fig. 2. Diagrammatic profile of the Comporta dune. S. seaward edge; L Lee side ; A and B the seaward and landward ridges The portions of the surface usually vegetateda re indicated by vertical strokes.

From this point the level drops a little and then continues east as a slightly uptilted table land, reaching its greatest height towards B. From this highest ridge the profile falls abruptly (about 32°) as the lee slope, forming the western boundary cf the salt marshes and cultivated alluvial ground.

Towards the northern end are the ruins of the Roman Settlement of Troia, and still further north a whaling station. In this region parts of the dune have been fixed by the planting of pines, etc., otherwise its main length is untouched, except for an occasional pine on the lee slope (Pl. XXIV., above). Nor is the dune frequented or otherwise interfered with by the local inhabitants.

Here and there the ridge is crossed from some hamlet for the collection of drift wood or to reach a boat on the shore. The habits of the peasants do not lead them to wander on the dunes for relaxation. One or two fixed slopes on the lee side are used for pasture, but otherwise the dunes are deserted and unspoilt, and the footprints of man are as rare as on Robinson Crusoe's Island.

As regards the travel of the sand: this is derived from the beach, and with much comminuted shell debris is driven up the shoreward slope. The main sloping plateau, much of which is bare, is being eroded by wind, the products finding their way to the lee slope where they rest at the critical angle of the material. The highest ridge, above this slope, is held by a sparing but tenacious vegetation. Irregular in its distribution, this vegetation holds minor ridges transverse to the length of the dune system, which sometimes stretch to join the shoreward slope (as in Pl. XXII.), though more frequently they die out on the plateau. The shoreward ridge is pitted by numerous blow-outs (Pl. XXII.), but its outer and inner slopes are the stronghold of the vegetation.

Texture of Dune

As already stated, the materials are coarse (c.f. analysis, p. 283) and this coarseness of texture has several important results. Whilst on the Blakeney dunes about 70 per cent. of the sand is between $\frac{1}{4}$ and $\frac{1}{3}$ mm., at Comporta 86 per cent. exceeds $\frac{1}{2}$ mm., and 42 per cent. ranges from $\frac{3}{4}$ mm. to 2 mm. in diameter.

A first consequence of this coarseness, reinforced by the power of the Portuguese sun, is the great dryness of the dune, especially of its surface layers—a circumstance undoubtedly reflected in the vegetation carried.

A second result is the relative immobility of the bulk of the sand in lighter winds. These, whilst drifting away the smaller particles, leave the larger undisturbed, so that the whole surface of the dune becomes enclosed in a thin mantle of large, immobile sand grains, extending to a thickness of several millimetres. Deeper down, finer material is found with the coarser, but at the surface the finer grains hardly occur at all. In the annexed table are given mechanical analyses of Comporta sand from the surface $\frac{1}{4}$ inch, and from this level down

COMPORTA DUNE PLATEAU WITH SCRUB, LOOKING NORTH

View of plateau of Comporta dune about 4 miles south of Comporta, looking north. The Atlantic Ocean is seen on the left. The vegetation consists of scattered shrubs with bare sand between. They include *Diotis candidissima*, *Helichrysum Stœchas*, *Crucianella maritima*, *Lavandula pedunculata*, *Lithospermum fruticosum*, and (on the right) conspicuous bushes of *Corema album*. Across the middle of the picture is a streak of *Triticum junceum*. (April, 1927.)

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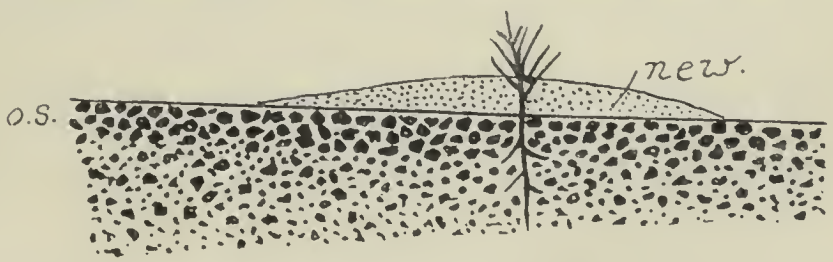
to 6 ins., expressed as percentages by weight of the whole sample. In the last column are given similar data for the Blakeney Point dunes. In all cases the figures represent the average of three determinations taken at random from different stations.

Size of Grains in mm.	Comporta Dune.			Blakeney Point.
	General Samples 1—6 ins.	Surface ¼ in.	Armeria Dune.	General Samples 1—6 ins.
above 1	8·1	33·7	—	—
1—·7	34 1	48·4	6·0	0 1
·7—·5	43 7	12·0	62·5	1 8
·5—·3	12·0	—	28·0	16 0
·3—·25	2·0	—	3·0	68·9
·25—·2	—	—	—	8 9
below ·2	—	—	—	4·1

Table showing mechanical analyses of Comporta and Blakeney Point dune sands, expressed as percentages by weight. Each column is the average of three determinations from different stations.

Where little new dune eminences arise upon the plateau this property of the sand has a marked effect. Thus on the occasion of one of my visits to Comporta on a certain spot, otherwise bare, shoots of *Armeria pungens* had recently grown out from the surface, and had collected around them a deposit of drifting sand. The grains composing these new dunes were of the smaller grade and contrasted markedly in size with those of the general plateau surface on which they rested (text fig. 3). These little dunes, which were only



TEXT-FIG. 3. Small new dune recently formed around an Armeria plant. The sand thus collected is of fine texture and is underlaid by the large grained old surface (*O.S.*). Deeper down finer grains are mingled with the large ones.

a few inches high, must have been formed from finer, mobile particles drifted out of the general mixture by winds of moderate velocity, which failed to disturb the larger particles. The composition of the sand of these little Armeria dunes is given in the fourth column of the table. Very little sand larger than .7 mm. is present. The texture of the surface, and of the underlying sand upon which these Armeria dunes rested, corresponded precisely with the figures of columns 3 and 2.

Taking the whole year through this extreme disparity in size must have an appreciable effect in the retardation of the travel of the dune as a whole ; for sand travel of any magnitude will be restricted to the occasions when strong winds and gales are blowing.

Though data are not available for the actual locality, I am indebted to the courtesy of the Meteorological Office (Air Ministry) for the following returns for Lisbon. For the ten years, 1908-1917, the average number of days per annum on which the wind exceeded 15 miles per hour was 79, whilst a velocity of 25 miles per hour was exceeded on 30 days only. The days on which these winds blew are distributed fairly evenly over the year.

It is only when such winds as these are blowing that the finer and coarser sand alike will get into motion, and the mechanism of automatic protection be broken up. With the resumption of calm weather the finer material will be drifted out of the surface, which will once more become reinstated as a protective mantle. The inference drawn is that the mechanism has a quite appreciable stabilizing value.

The actual advance of the lee slope is obviously very slow as compared with dunes of ordinary texture, and no special measures are taken to protect the ground invaded. As much of this is valuable, irrigated ground, complaints would be heard were it being seriously threatened (map, text fig. 1).

Theoretically, all dunes showing disparity of size between their sand particles may be expected to exert a similar action for a certain range of winds, but where the larger grains average less than $\frac{1}{3}$ mm. (as at Blakeney) the protection given against sand drifting in mass would be negligible.

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COMPORTA DUNE, LOOKING SOUTH

View of dune plateau 1 mile north of Comporta, looking south, towards Cape Sines. The seaward side carries the usual open formation of low shurbs of which *Thymus carnosus* is seen in the foreground. On the left is much bare sand, and it is here that the *sand sheaths* are becoming exposed. The grass in the foreground is Marram. (April, 1927.)

The Vegetation

The plants of the Comporta dune are strikingly different from those of our familiar English coast, both in species present and in their manner of distribution, though, apart from ephemeral forms, both northern and southern types agree in the possession of some or other mechanism enabling them to conserve their water supplies. In the case of the Portuguese dune plants these mechanisms are outstanding—as well they may be considering the great insolation to be endured.

The main vegetated areas on the Comporta dune extend (1) from the beach to the crest of the seaward ridge, (2) from this crest down the short slope to the beginning of the gently rising plateau and up this for an indefinite distance, varying from 100 to 300 or 400 yards. The ground beyond is generally bare, such areas often being extensive, as in Pl. XXIII, and amounting to more than half the total dune surface ; (3) the high landward crest also carries plants, whilst the lee slope shows patches of vegetation (Pl. XXIV, below). Occasionally, where owing to some topographic peculiarity, the lee slope has not been overlaid for some years by drifting sand, a fairly dense vegetation may establish. Such exceptional slopes alone are grazed.

Grasses occur on the seaward slope where there is much *Triticum junceum*. A few streamers of this radiate beyond the crest, but to no great distance. *Psamma arenaria* is also present here, but in very sparing quantity—a remark which applies to its occurrence on the landward crest and lee slope (Pl. XXV., below). In general, Marram Grass thrives indifferently in Portugal, and contrasts markedly with its normal growth in higher latitudes. The conditions are probably too dry and hot for this grass to flourish. On the non-mobile parts of the lee slope, Dactylis, *Arrhenatherum bulbosum*, and *Corynephorus canescens* may occur. On the whole a turfy carpet of grasses is rarely found on our dune.

The outstanding feature of the vegetation is a growth of low woody shrubs, about 2 feet high and separated by bare sand. Wherever this bush formation extends the ground is fairly well sheltered and not much sand is blown away. The plants contributing belong to a dozen or more species, and for the

most part come into flower at a later date than that of my visits (April).

The most conspicuous shrub is *Corema album* (Empetraceæ) reaching 3 feet in height and of spherical habit. By its form and dark evergreen foliage it can be recognised from afar (scattered plants with rings of bare sand round them in Pl. XXII., on the right). Its large rolled leaves are just like those of our *Empetrum nigrum*, on a magnified scale, and show the same adaptation. The roots of this plant are peculiar ; they consist of numerous strands spirally twisted together like a rope. The collective structure descends vertically into the ground for 3 or 4 feet. Whether the unit-strands are actually secondary roots, or sectors into which an original primary root has separated, is uncertain. The plant bears white berries.

Lithospermum fruticosum, an erect, twiggy bush, which in April is a mass of brilliant blue flowers visible from afar.

Lavandula pedunculata, which is conspicuous everywhere in waste places in Portugal (Charnecas), flowers freely in April. The flower heads are on long stalks and are crowned by prominent purple *bracts*. The plant is sold in bunches in the streets of Lisbon at Easter, and would serve very well as the Portuguese national emblem.

Diotis maritima and *Helichrysum Stœchas* are a pair of low composite shrubs everywhere common, the former being especially abundant on the seaward ridge. Both these have their leaves swaddled in white cottony hairs, the first named in particular.

Resembling these in habit, with imbricating leaves in opposite pairs, is the curious *Crucianella maritima*, not easy to recognise as the close ally of *C. stylosa* of the garden.

Then there are several species of Armeria—mostly much bigger plants than our own thrift. In this genus the Portuguese Flora is particularly rich, more than 20 species being represented. On the Comporta dune *A. pungens* and *pinifolia* are frequent as little bushes in these thickets.

Of other shrubby plants mention may be made of *Thymus carnosus* and *Anthemis maritima*.

Associated with this open scrub is a beautiful and interesting flora of herbaceous plants and bulbs, at the height of their

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COMPORTA DUNE, FROM THE EAST

The Comporta dune seen above the irrigated rice fields, half a mile distant. In the foreground women are hoeing ground before the grain is broadcasted on the water. Two miles south of Comporta. (April, 1926.)

LEE SLOPE OF COMPORTA DUNE

Landward (lee) slope of the Comporta dune abutting on the *Juncus maritimus* zone of the salt marsh. The conspicuous plants on the dune slope are cushions of *Ononis ramosissima*. Two miles north of Comporta. (April, 1927.)

flowering in April and May. The whiteness of the naked sand shows off their brilliant colours to perfection.

Dotted about everywhere is the charming *Senecio gallicus*, its yellow flowers rendered distinctive by a touch of orange. It is one of the few annuals of the Comporta dune.

Among the yellow-flowered plants must also be numbered *Lotus arenarius v. canescens ; Medicago marina*, with its pale, silk clad leaves prone on the ground and sessile heads of lemon yellow flowers between ; several species of Linaria, including *L. lusitanica*, *spartea*, *saxatilis*, and *Ficalhiana*—all these a great feature.

Among the crimsons and pinks are several low growing Silenes, *Malcolmia littorea v. Broussonetii* and *M. patula v. gracillima*, and the delicious rose-coloured *Ornithopus roseus ;* on the lee slope restharrow (*Ononis ramosissima*) abounds in substantial patches, with luxuriant dark green foliage (Pl. XXIV., below).

Spread in mats prone on the ground is *Paronychia argentea*, the bracts of its flowers glistening like frosted silver against a white background of sand ; occasional specimens of the Reseda-like *Astrocarpus sesamoides* are also to be found, whilst deep hues of purple are supplied by *Anchusa undulata*, especially on the seaward ridge where the sand is rich in lime.

Our own familiar *Carex arenarius* is an absentee, but its place is taken by the robust *Schoenus capitatus* of identical habit.

A feature is provided by the numerous bulbs scattered about among the other plants. The large squill, *Urginea maritima* and the sand narcissus, *Pancratium maritimum* both occur on the seaward slope, but do not flower till later in the season. Small blue scillas, and a small white-flowered snowflake, *Leucojum trichophyllum*, are not uncommon, whilst here and there the yellow *Iris lusitanica* may be found.

Along both margins of the dune are quantities of *Crepis bulbosa*, now in flower. This plant has thread-like underground runners radiating in all directions and each ending in a spindle shaped, translucent, water-holding tuber, from which next year's growth will start.

The above is but a selection from the bright constellation of plants belonging to the Comporta dune. Of them Professor Chodat has justly remarked, " Not a weed is visible here ; each

plant is separate as in a cared for garden, in which one might fancy the beds had been hoed by an invisible gardener."* To a stranger the variety of species in small compass is bewildering (in a landscape such as is given in Pl. XXII. all these plants, and more besides, are to be found), whilst the rich colouring everywhere displayed by the flowers is something incredible to an Englishman. Though any true comparison with Alpine flowers is out of the question without placing the plants side by side under the same conditions, the impression I got is that these dune plants more than hold their own with the alpine colours. Some day perhaps the matter will be investigated from the point of view of ultra-violet rays. So far as sunlight is concerned I can only state my experience of two Aprils spent in Portugal. On both occasions I had not more than one dull day, and a few squalls on other days. It was a land of perpetual and penetrating sunshine.

For its atmospheric effects the Comporta dune is noteworthy. Its white sand takes the colours from the sky—often an after-glow at sundown—whilst the fact of its alignment due N. and S. produces a maximum contrast of morning and evening effects. The distant landscapes, which have at least as much value in dune scenery as in other types, include the high ridge and summits of the Serra d'Arrabida to the N. seen over the estuary leading to Setubal ; to the E. the salt marshes, irrigated ground and unending spread of Charneca on the settled dunes ; to the S. the blue mountains of Grandola and the dune ridge curving out to Cape Sines twenty miles away ; whilst to the W. is the Atlantic with its rollers beating on the foot of the ridge.

The Older Dunes

It is not the purpose of the present article to deal with the older systems of sand dunes of the Comporta area, of which there are many scores of square miles. It must suffice to say that their soils are derived from the same initial type of coarse quartz sand that forms the active dune we have been describing ; but in process of time a rich humus has developed so that some of these soils are coal black, others chocolate, and others of lighter shade. Left to themselves these dunes become

* R. Chodat, Excursions Botaniques en Espagne et au Portugal, Geneva, 1909, p. 40.

covered with a dense scrub, waist high, in which Ulex, Genista, Rosemary, Cistus, and Juniper become important, as well as Corema and others of the plants already mentioned. *Pinus pinea* and *P. pinaster* flourish when planted, and become naturalised, whilst experiments are in progress with different species of Eucalyptus to discover those best suited to the conditions.

To-day, after many years, parts of these old dunes are being burnt over, grubbed, ploughed and sown with wheat, rye, beans, and other field crops, and every year the zone of cultivation expands. The truth is the Comporta district, apart from the irrigated ground where rice is grown, and certain favoured spots, has never been seriously exploited. This agricultural backwardness means that many scores of square miles of old sand dunes remain in the "Matto" or Charneca phase, producing nothing of any value except pine trees and wood for kindling. The direction of the land is now in good hands, and production is increasing. But in any event it must be a long time before these fragrant prairies of waste land (Charneca) are fully reclaimed for tillage.

As things now are this country is full of interest to the Ecologist. The Matto is not homogeneous, but the mixture of shrubs varies from one place to another. Ground carrying Genista, Ulex, Cistus, and Juniper is said to make good arable, whilst Corema is a sign of poor land. These notions are being put to the test, and experience gained of what fertilisers are needed to correct the deficiencies of the natural soils. Comporta would be an ideal place for an Ecological Station—something less ambitious than our Rothamsted Laboratory.

Curious Structures

In concluding this account, reference may be made to certain curious objects which occur on the main Comporta dune, viz., tubes of cemented sand in little heaps along a line on the bare plateau midway between the shore and marsh. These tubes vary in diameter from 2 or 3 to 60 or 70 mm., and consist of coarse grains of quartz cemented together by a matrix of carbonate of lime. These tubes have been variously attributed to insects, worms, and lightning.

The first point to be noticed is that where the tubes occur

sand is being blown away, so that they are ancient structures coming to light. Moreover by following the line or horizon of occurrence, in addition to those lying prone, tubes are found at places *in situ* standing out from the surface as in our photograph on Pl. XXV., above. Where this is the case the smaller upstanding tubes may be traced down into larger, horizontally disposed tubes, and below these, on excavating, a plexus of much finer tubules is discoverable—the whole suggesting that these structures have been formed as incrustations around the bodies of dune plants of a former day. Often the cavity contains a core of humus, and the state of preservation in some cases suggests that, on examination, definite evidence would be obtained as to its source. Examination on the spot of the underground organs of living dune plants of comparable size revealed no trace of such sheaths, so the presumption is that if these incrustations are of vegetable origin, they are a *post mortem* development, the cement being a derivative of the shell debris present in the sand. Through the courtesy of Professor Adamson of the University of S. Africa (Cape Town) I have had an opportunity of comparing the Comporta structures with tubes derived from the dunes of the Cape Flats. The agreement is extremely close, and no doubt the conditions under which they were produced are substantially the same.

In Gerhardt's "Deutches Dünenbau" reference is made to the frequency with which fulgurites are found where the sand is blown away on dunes of the German coast and elsewhere. These fulgurites (Blitzenröhren) are supposed to have originated from trees struck by lightning; the lightning as it found its way by the branching roots to the water table fusing the sand into a vitreous sheath, in the outer parts of which unfused grains of quartz remained embedded. In our case the sheaths show no trace of vitrification, the cement being entirely calcareous, so that their origin must have been different. Besides, on the lightning hypothesis, we should have to suppose that all along the line of the horizon in process of exposure—it extends for miles—every tree of some past epoch had been struck by lightning! As both the structure of the tubes, as well as their distribution on the ground, are opposed to the fulgurite theory, it seems probable that, when the specimens from Comporta and S. Africa are

SAND TUBES ON COMPORTA DUNE

Cementated sand sheaths of ancient dune plants (*in situ*) being exposed as the sand is blown away. In front are several tubes, belonging to a slightly higher level, which have toppled over. (April, 1927.)

LANDWARD RIDGE WITH MARRAM GRASS

Edge of plateau of Comporta dune above lee slope showing sparse distribution of Marram Grass. (April, 1927.)

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fully examined and compared with other analogous structures, some other explanation will be forthcoming.

A Portuguese dune like that at Comporta differs markedly from its opposite number at home. It is much drier, and the plants (for the most part other than those we know) exhibit more conspicuously the structural qualities (termed xerophily) which include hairiness, leatheriness, rolled leaves, and water storing tissues. Grasses are unimportant in the vegetation and such a typical dune landscape as wind swept hillocks and stretches of marram grass overrun by ragwort does not exist. The vegetated regions carry a scrub of low bushes heterogeneously assembled, and on the bare sand between occur chiefly perennial herbs with flowers of brilliant hue. As usual the flowering period coincides with the forepart of the season, April and May being the months of maximum display. Variety in detail, even on quite small areas, is the rule, but the general effect of the whole borders on the desert type from which it is saved by the genial rains of winter and the moisture which the Atlantic brings.

III

METEOROLOGICAL NOTES, 1926

(From observations taken at Norwich)

By Arthur W. Preston, F.R.Met.Soc.

JANUARY

The mild weather which set in at Christmas, 1925, continued until January 12th, when it gave place to nine days of a severity unparalleled except in our coldest winters. On the night of the 15th the thermometer fell to 14.5 deg. in the screen and to 10.2 deg. on the ground, and on the following night to 12.2 deg. and 11 deg. respectively. These were the lowest temperatures recorded here since the 9th February, 1919. Some of the day maxima during this period were remarkably low, the thermometer not rising above 28.8 deg. on the 11th and 27 deg. on the 15th. There were considerable snows during this cold

period, but at no time did they equal those of the previous November, the greatest depth on the level here not exceeding four inches. On the 23rd there was a sudden change back to mildness, the temperature at 9 a.m. on that day having been 16 deg. warmer than at the same hour on the previous day. This mild weather continued until the end of the month.

FEBRUARY

The mild weather continued throughout February, the mean temperature of which month (44.3 deg.) was the highest recorded since 1869. There was only one night with frost in the screen, and on 16 days the day temperature exceeded 50 deg. Snow fell on one day only, and then to a very trifling extent. Rainfall was slightly above normal, and there was much cloud during the first half of the month, reducing the month's sunshine to 44 hours. The continued mildness brought on a very early start of vegetation.

MARCH

This month was notable for its abnormal dryness, the total rainfall having been but .37 in., constituting the driest March since 1874. Strong winds and gales prevailed between the 3rd and 12th, and the weather was very mild to the 16th, after which a winterly spell occurred, with snow on the 21st, as often happens at this period. The mean temperature of the month (44 deg.) was 2.5 deg. above the average, but slightly lower than that of February.

APRIL

Summerlike weather prevailed during the first six days, with temperatures more in accordance with July than April. On Easter Day (4th) the screened thermometer rose to 74.5 deg., being the highest temperature recorded here so early in the season since 1892. The month's mean temperature (50.3 deg.) was the highest in any April since 1874. There were some rather cold days in the latter part of the month, accompanied by much cloud, and the month's sunshine was 52 hours below the average. There was hardly any ground frost.

Rainfall was over an inch in excess. Thunder occurred on the 8th and 19th, on the latter day accompanied by large hailstones.

MAY

The weather was cold and unseasonable down to the 20th with hardly a day which could be called moderately warm. During the last ten days of the month, particularly during the Whitsun holiday, warmer weather prevailed, but on no day did the thermometer exceed 73 deg. Rain fell daily from the 4th to the 15th, (on which latter day there was a little snow) and some frosts occurred in the second week, doing much injury to the apple crop. Rainfall was half-an-inch below normal, notwithstanding that rain fell on twenty days. Sunshine was slightly in excess of the average, and there was a considerable preponderance of north-east winds.

JUNE

The outstanding feature of this month was the tropical thunderstorm which passed over Norwich on the afternoon of the 17th. This storm worked up from the north against a southerly undercurrent, and burst in its full fury over the city between one and half-past continuing until well after 3 p.m. The lightning was of unusual intensity, and the hail fell in such torrents that it was in places swept up after the storm in heaps nearly two feet high. The rainfall recorded here during the storm was .72 in., and it is stated that about half-an-inch fell in five minutes. During the earlier days of the month much dull, cool, and showery weather prevailed, and there was but little heat, the thermometer reaching or exceeding 70 deg. on four days only Rainfall was .78 in. in excess of the average, and sunshine was 43 hours deficient.

JULY

The weather of this month was unsettled at times, but there were some very fine periods, that between the 11th and 14th being accompanied by great heat, the thermometer rising to 80 deg. and above on four successive days. Rain fell on eleven days only, and the month's total was nearly an inch below

normal, and sunshine was 20 hours deficient. There was a sharp thunderstorm on the evening of the 9th, and another, more severe, about midnight on the 18th-19th, with very sharp lightning, but not much rain. This storm was, however, very widespread, and in some places in the West and North-West of England the most severe for many years.

AUGUST

The weather of August was, on the whole, fine, pleasant, and summerlike, and favoured both the harvest and the holiday maker. Although the rainfall was a trifle above the average, two-thirds of the total fell in heavy thunderstorms on the 10th and 11th. The thermometer exceeded 70 deg. on 17 days (which are more days than in any August since 1918), but did not quite touch 80 deg. Sunshine was 20 hours in excess of the normal, and with the exception of 1923 was the largest amount registered in any August since 1911.

SEPTEMBER

The weather was warm for the season down to the 20th day. On the 19th the thermometer rose to the exceptional height of 86 deg., this being the highest reading so late in the season since these observations were commenced in 1883. The last ten days of the month were unseasonably cold. The contrast between Sunday the 19th, and the following Sunday was remarkable, the latter day having been as much as 33 deg. colder than the former. Notwithstanding this cold spell the month's mean temperature was 2.3 deg. above the average, and it was the warmest September since 1898. Rainfall was only about half the average, the severe thunderstorm on September 1st which caused so much rain in London and neighbourhood not extending to these parts. Sunshine was about five hours deficient, this being due to some very dull days at the beginning of the month.

OCTOBER

The month opened with a week of magnificent weather, with constant sunshine, reminding one much of the same period in 1921, but less warm than in that exceptional year. On

the 6th the temperature touched 70 deg., and the mean temperature of the first eight days was nearly 8 deg. above normal. Following a gale on the 9th an unsettled and cold period set in, and from the 15th to the end of the month the weather was quite winterly. While we were spared the snowstorms and intense frosts which occurred in many parts of the Kingdom the cold here was, nevertheless, of an intensity but rarely felt in October. There were no fewer than 14 days when the thermometer failed to rise to 50 deg., and frost occurred on the grass on 13 nights, the lowest reading having been 22 deg. on the 26th. Rainfall was rather under normal, and sunshine 21 hours in excess.

NOVEMBER

This was a dull month with much rain at times, and considerable fogs towards the end of the month Mean temperature was rather above the average, and the thermometer exceeded 50 deg. on 13 days. There was a remarkable absence of frost, the sharpest night having been on the 1st, when the thermometer fell to 28.9 deg. in the screen and to 23.8 on the grass. After the 1st there was not another frost in the screen until the 26th. The total rainfall was about half an inch in excess of the normal, but fell very far short of the large amounts of rain registered in many parts of the South-West of England. Total sunshine was only 42 hours, of two-thirds of the normal. There were eight days absolutely sunless and 11 other days on which the sun shone for less than an hour. Very low barometer readings occurred on the 19th, 20th, and 21st, the mercury remaining below 29 ins. for 65 hours, and descending to 28.59 ins. on the 20th.

DECEMBER

This month was finer and drier than November, with 57 hours of sunshine and only half its normal rainfall. There was but little frost, and although the thermometer fell below the freezing point on the grass on 23 nights, the frosts were but slight. Snow fell on the 20th, and further storms of sleet and hail occurred on the two following days. Mean temperature was 0.5 deg. above normal. The barometer rose to 30.58 ins. on the 10th and to 30.72 ins. on the 23rd.

The Seasons

Tables of Mean Temperature and Rainfall of the four seasons of 1926 (including December, 1925, but excluding December, 1926), and compared with those of the five previous years and with the average.

Temperature

Seasons	1921	1922	1923	1924	1925	1926	Average for 30 years.	Departure of 1926 from average
	degrees	degrees	degrees	degrees	degrees	degrees	degrees	degrees
Winter -	41·7	40·2	41·3	37·3	41·6	39·7	38·4	+ 1·3
Spring -	49·6	46·9	47·3	46·7	47·6	48·5	46·7	+ 1·8
Summer -	62·1	57·9	60·3	60·2	61·5	60·6	60·2	+ 0·4
Autumn -	51·3	48·4	47·8	51·2	48·2	50·3	50·1	−0·8
Year - Jan. to Dec.	51·5	48·3	48·7	49·4	49·2	50·0	48·8	+ 1·2

Rainfall

Seasons	1921	1922	1923	1924	1925	1926	Average for 35 years.	Departure of 1926 from average
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Winter -	5·58	9·86	8·07	7·40	6·06	7·26	6·21	+1·05
Spring -	4·17	5·32	3·95	6·58	6·31	4·70	5·55	−0·85
Summer -	2·57	10·54	6·45	6·08	4·65	6·92	6·89	+0·03
Autumn -	4·65	6·06	8·84	10·86	8·51	7·01	7·83	−0·82
Year - Jan. to Dec.	15·71	32·49	27·74	30·77	25·10	24·66	26·48	−1·82

The winter, notwithstanding exceptionally severe spells, was, owing to the mild February, 1.3 deg. above the average temperature, the spring was nearly 2 deg. above and the summer slightly above. The autumn was colder than usual, although less so than in the previous year. The winter's rainfall was about an inch beyond normal, that of the spring showed a deficiency of nearly the same amount. That of the summer was in close agreement with the average, while the autumn was somewhat deficient in moisture.

The Year

The mean temperature of the year (50 deg.) was higher than that of any year since 1921. The hottest day was September 19th (86 deg.), and the coldest night was January 16th-17th (12.2 deg.). January, February, March, April, July, August, September, November, and December all gave mean temperatures higher than the average. The other three months were colder than usual, the most markedly cold month being October. It was notable that both the earliest and latest high readings of the thermometer for many years occurred in 1926, the high reading of 74.5 deg. on April 4th having been (as previously mentioned), the highest so early in the year since 1892, and the high reading of 86 deg. on September 19th having been the latest reading of so high a temperature since these observations were commenced in 1883. The year's rainfall was 1.82 ins. deficient. The wettest month was November with 3.09 ins. of rain, and the driest was March with only 0.37 ins. The sunniest month was May with 213 hours of bright sunshine, and the dullest months were February and November with 45 and 42 hours respectively. The total year's sunshine (1469 hours) was 114 hours below the average, and such total was the lowest of any year since 1916, when there were only 1260 hours. Mr. Willis has again most kindly supplied the readings from his Campbell-Stokes sunshine recorder. A remarkable feature of the year was the magnificent weather which prevailed upon each of the four Bank Holidays. There were some severe thunderstorms during the summer, the most notable here having been that of Thursday afternoon, June 17th, above alluded to, but that of the night of July 18th was in many parts of England far more severe. The writer happened to be visiting the English Lake District at the time, where the full force of this storm was experienced, and it was, without exception, the most terrific and alarming electrical display within his recollection. The instruments at this Station were inspected and examined on September 28th by Mr. Read, one of the Inspectors of the Meteorological Office, who reported all as satisfactory. He was much impressed with the maximum and minimum and dry and wet-bulb thermometers, all of which had been in daily use for over forty years, and in no case had changed by more than one-tenth of a degree; two of them had not changed at all and were absolutely correct.

MR. PRESTON'S METEOROLOGICAL RECORDS FOR 1926

Month 1926	BAROMETER					THERMOMETER					HYGRO-METER	SUN-SHINE	RAINFALL		WIND								
	Highest	Date	Lowest	Date	Mean	Highest	Date	Lowest	Date	Mean	Mean Relative Humidity 9 a.m	Hours	Inches	No. of Days	Direction and Days								Mean estimat'd force
															N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	
	in.		in.		in.	°		°		°	%												
Jan.	30.41	12	29.33	3	29.829	52.7	25	12.2	17	38.3	90	56.4	2.78	21	0	1	2	6	13	2	5	2	2.9
Feb.	30.52	28	29.25	2	29.821	56.5	26	29.4	14	44.3	87	44.5	1.95	16	3	3	2	3	3	7	6	1	3.1
March	30.48	1	29.41	27, 28	30.002	59.0	8	28.5	25	44.0	77	119.7	0.37	9	5	3	5	1	1	4	9	3	3.9
April	30.22	5	29.21	20	29.836	74.5	4	33.3	13	50.3	78	107.5	2.81	18	2	6	3	5	2	6	3	3	2.4
May	30.11	25	29.45	30	29.852	73.0	26	33.7	9	51.3	74	212.6	1.52	20	4	8	1	4	2	5	3	4	3.9
June	30.38	29	29.41	10	29.885	77.0	20	42.0	26	57.1	78	163.0	2.71	19	7	4	2	3	1	3	5	5	3 1
July	30.33	31	29.54	25	29.993	83.0	12	45.1	27	62.5	75	190.2	1.67	11	6	5	5	2	2	4	3	4	3.0
Aug.	30.37	28	29.67	11	30.010	78.7	31	43.5	5	62.1	75	205.1	2.54	12	9	2	1	2	3	5	6	3	3.2
Sept.	30.40	30	29.66	12	30.048	86.0	19	38.0	26, 27	59.4	84	144.0	1.14	12	0	3	1	2	2	7	5	10	3.0
Oct.	30.46	4	29.23	25	29.866	70.2	6	26.7	27	47.3	81	126.2	2.78	20	5	2	6	1	1	4	6	6	3.0
Nov.	30.21	25	28.59	20	29.608	55.0	11	28.9	1	44.2	91	42.1	3.09	21	0	1	2	7	9	5	5	1	2.8
Dec.	30.72	23	29.60	3	30.217	50.0	28	28.4	27	39.4	89	57.3	1.30	15	3	4	2	1	0	4	7	10	2.9
Means					29.914					50.0	82												3.1
Extremes & Totals.	30.72	Dec. 23	28.59	Nov. 20		86.0	Sept. 19	12.2	Jan. 17			1468.3	24.66	194	44	42	32	37	39	56	63	52	

IV

BIRD NOTES, 1924-26

By A. H. Patterson

The following notes are offered in continuation of those published in the Transactions for 1922-23.

1924

Black-Throated Diver

A rather unusual number of Black-throated Divers appeared on the East Norfolk coast during the winter of 1923-24. An adult in full winter dress was brought to me sadly smeared with petrol waste, and I received also a younger bird, in better condition, which was picked up on the beach. Two others were received by Mr. E. C. Saunders, from one of which he took three six-inch Bream and four Smelts. One of these Smelts was four inches long.

Birds and Crustacea

Crustacea provide a favourite and easily obtained food for many wading birds; but Starlings and Sparrows have also acquired a liking for shrimps and repair to the boats of the shrimpers, particularly in the nesting period, picking the shrimps out of the emptied baskets and from the nets hung up to dry. I have even seen domestic fowls board the shrimpers for the same purpose. Rooks prowl along the mud-flats filling their gular pouches with stranded crustacea and taking them to their nestlings in the churchyard trees.

Grebes Feather-eating

When hidden, early in June, in a bird-photographer's hide on the edge of the Decoy Broad at Horning, I had for some time several Grebes—evidently males—under observation. A male bird was very busily attending to his striped young one. I saw him deliberately bend his head, snatch a feather from his neck, and swallow it. Keeping watch on him, I saw him pluck a second from near his tail and swallow that also. Mr. King, to whom I mentioned the fact, could scarcely believe it, but himself looked for this curious trick, and afterwards assured

me that he had seen a male Grebe, quite close to him, flick off a back feather and offer it to his baby bird, which at first refused it. When, however, the feather was dipped in the broad the little fellow seized and swallowed it. When discussing feather-eating with a broad-man I was assured by him that a bird stuffer, when skinning some Great Crested Grebes, found quite a ball of feathers in the stomach of each.

Food of the Little Owl

There can be no doubt that the Little Owl has come to stay, and also that it commits crimes that are inexcusable to the game-keeper. That it makes some amends is also equally certain. Master Ted Ellis, a boy naturalist friend of mine, exploring a wood, found a nesting place of a Little Owl in a hollow tree, from which he extracted a pint or more of hard remnants of Cockchafer beetles, with a few remains of other beetles. I myself found the " husks " of Rose Chafers, violet beetles and some others. At Catfield Fen in June I found hundreds of Little Owl pellets of which I took away a handkerchief full. On disintegrating these at home I found them to consist of the skulls and fur of the Little Shrew, among which were a few skulls which appeared to be those of bats—not a feather among them !

1925

Wild Geese

Geese were exceptionally numerous in the winter of 1924-25, and their flights from the marshes to the sea and back were a daily feature. They were most numerous on February 19th, when several flocks of over 1,000 were seen. During a gale earlier in the month a lot of tired geese alighted in a Yarmouth North-end allotment. The gardener cautiously crept in line with a shed hoping for a chance to spear one or more with a pitch-fork, but the wind, suddenly rattling a loose sheet of corrugated iron, put the birds to sudden flight.

Food of the Bittern

A well-known river man, when rowing me across his little broad, assured me that a pair of Bitterns nested in a quiet

corner, and that, on suddenly disturbing one of them, it promptly vomited five young birds which he believed to be Reed Warblers. A wounded Bittern sent to me from Aldeborough for treatment, was exceedingly vicious as well as shy. It took its food slyly, when my back was turned. Later it became somewhat accustomed to my presence and to my handling of its mending leg; but I had to cover its head with a sack to save my hands and eyes. Whitings up to four inches in length were readily taken and the wind-pipes of sheep cut into strips, as well as sliced plaice. Rats he sampled—chopped up—but afterwards objected to them. I gave him his liberty on Somerton Broad on March 17th, 1926. He had a last shot at my face as I turned him out of a tub, but missed me by inches.

Gull-billed Terns

(Note dated May 16th) "Saw four Gull-billed Terns flying up and down Breydon channel. They had black feet and bills, and looked rather dark on the feather ends of the wings. Flight seemed more like that of the Black-headed Gull than of the Common Tern. Got so excellent and close a view that I could not be mistaken. They seemed to be after insects on the surface of the water; no 'herring syle' was visible. They were there some hours." Of the ten examples of this Tern killed in Norfolk nine were obtained on Breydon.

Wounded Knot

The Knot is one of the most delightful of Breydon visitors—lazy, unsuspicious, and fond of the company of any waders that will tolerate it. One with a broken wing was brought to me on September 20th. I set its wing, and next day it ate as if nothing had happened. The third day it was content with earth-worms; on the fourth it accepted sliced beef, mixed with small worms and dropped into its water dish. On the fifth day it eagerly took common sand shrimps—tails first. Later, it fed on beef snips mixed with boiled potato, and daintily sampled egg pudding; but preferred worms to all else.

Hawk after Dunlin

On October 10th a Kestrel, hovering over a flock of some hundred Dunlin, singled out one of them which dashed towards

a drain and, flying low, much bothered the hawk, which hesitated to seize it above the water. The Dunlin shrieked, as one forcefully blows into a box-key ; on which a flock of about thirty Curlews flew to the rescue and chased the hawk away for a considerable distance.

Rock Dove

On December 9th a dove was picked up dead at Ludham which had been wounded in the breast. It was sent to me with a letter in which it was suggested that it might prove to be a Rock dove (*Columba livia*), an opinion with which I agreed. The bird was sent to Dr. Riviere, and was also examined by Mr. Witherby and Captain Lea Rayner. The latter, who is an expert on homing pigeons, considered it unlikely that it could be the produce of any domestic pigeon. The severe weather prevailing, with northerly snow storms, was probably responsible for its presence in Norfolk. The Yorkshire cliffs are undoubtedly its nearest breeding place.

1926

Kestrel and Natterjack Toad

On July 12th I gave my Kestrels a Natterjack toad to look at. The birds watched it with much interest from a branch, and one flew down, seized it with one foot, and bent over to bite it. The toad thereupon exuded a quantity of moisture, to the evident surprise and dismay of the bird, which hopped back to its roost with a very human effort at expectoration—as of one ridding the tongue of a hair.

It may be interesting to add that my tame Natterjacks objected to Cinnabar caterpillars and spat them out after trying one or two, wiping their wide mouths with their dainty fore feet.

Huge Jackdaw's Nest

Through the courtesy of Mr. Reginald Gurney of Spixworth I visited an enormous nest of sticks piled up by Jackdaws in order to reach a window of exit in a loft. It was shaped like a half-cone, the base being 21 feet round.

Birds and Walnuts

In my little garden at Hellesdon we had an aged hollow walnut tree. It was a famine year for the nuts and the few, that would scarcely fill a pint pot, were mostly appropriated by Starlings who attacked them when they were softish, and by Rooks when further ripened. It is odd how various creatures attack the same prey. The Squirrel nibbles the small end of a nut and then splits it with his incisor teeth ; the Nuthatch fixes the nut in a crevice in the bark of a tree, hammers it tight, and then pecks a jagged hole to get at the meat. The Long-tailed field-mouse nibbles a small hole and by some means gets the inside out daintily. Equally interesting were some observations on the way in which Hares, Rabbits, and Rats individually attack beet in a field.

V

THE HERRING FISHERY OF 1926

By A. H. Patterson

Owing to my retirement and removal from Yarmouth for a season I lost touch greatly with the progress of the herring fishery of 1926 ; while materials of an interesting nature were destroyed by an accident on my return. I am, however, able, through the courtesy of Mr. A. C. Canham, to piece together a fairly connected review of the season.

The 1926 Herring Voyage began with the heavy handicap of the great coal strike. The sailing boats—both English and Scotch—had vanished, entirely superseded by steam and motor craft ; consequently the rise in price of coal to £3 10s. 0d. and later to £4 16s. 0d. per ton badly crippled the industry. Added to this, the weeks of stormy weather which obtained when the season is usually at its height did much damage to the nets. These discouragements so depressed the northern fishermen that, to quote Mr. Canham, " they cut their losses by leaving earlier." This is not surprising when long spells of bad weather kept the boats in port and inferior coal from the continent made steam-raising difficult.

The Yarmouth Herring Fleet comprised 833 fishing boats in all, classified as follows :—

	Steam.	Motor.
Scotch	609	105
Yarmouth	110	
North Shields	6	
Other ports	3	

The Lowestoft fleet consisted of 470 vessels, as follows :—

	Steam.	Motor.
English	246	1
Visiting boats	188	35

The preceding statistics were sent to me by the Lowestoft Office of the Ministry of Agriculture and Fisheries. From the same source I am given to understand that 3,498 Scotch girls were employed at Yarmouth and 1,302 at Lowestoft. Also that the total of Herrings landed at Yarmouth was 393,870 crans, of an estimated value of £553,816.

Weekly Landings of Herrings at Yarmouth.

	Crans. 1925.	Crans. 1926.
October 2	42,208	16,280
,, 9	43,418	11,920
,, 16	32,366	44,872
,, 23	79,146	143,784
,, 30	143,535	52,727
November 6	87,527	45,999
,, 13	15,372	43,829
,, 20	20,411	19,688
,, 27	6,035	8,007
December 4	7,216	3,766
,, 11	2,007	2,196
Season's Total	479,241	393,068
Decrease on the Season ...	86,173 Crans	

Record Year Catch (1913) ...	824,213 Crans
Drifters Fishing	999 vessels
Barrels (Salted) Exported	820,527

The fishing opened fairly well and, as shewn, October saw the largest catches. The heaviest catches delivered in one day, October 21st, amounted to 34,793 crans, the produce of 519 boats. The smallest catch was delivered on December 1st when one boat landed 30 crans. The highest price obtained was £4 14s. 0d. per cran, which figures out at £47 per last (old style) of roughly 13,200 herrings. The date of this record price was December 6th.

The lowest figure recorded was 17s. per cran on October 21st. This would correspond to £8 10s. 0d. per last. According to Mr. de Caux ("The Herring and Herring Fishery") he had known "fresh herring and 'bloater-stuff,' occasionally bring wholesale prices of £40 to £56 per last." The heaviest shot was 250 crans—a quarter of a million fish ; this was landed by a Yarmouth boat on October 21st and realised £245. This was not a profitable catch, as it happened, for half her fleet of nets was damaged or destroyed, a loss which cost over £250 to replace. On the same date another local drifter, the "Ascendant," landed 250 crans, and another 240 crans. A Lowestoft boat which came in with 218 crans, the result of one trip, lost 30 nets through the weight of the herrings "grounding" (sinking) her nets. The bulk of the herrings are stated to have been captured near Smith's Knowle. In round figures the value of the Yarmouth catch was £600,000, as compared with the 1925 catch of about £850,000.

Yarmouth for many years has depended largely on the export of its herrings, "Pickles" (brine-cured fish in barrels) having been in great demand in certain European countries, particularly Russia. The chaotic state of that unhappy country has now made it impossible to continue trading with her people, although Russia may be drawing supplies through neighbouring States. The season's pickling was 338,632 barrels, as compared with 422,190 the previous year. Shippings have been made to Danzig, Stettin, Reval, Libau, Riga, Hamburg, Ymuiden, and other northern ports. The first export steamer to load was the "Ralum" of Königsberg on October 21st. One vessel, the "Glenderry" carried 7,728 barrels on one trip in November to Stettin and Königsberg.

The "Fresher" export known as "Klondyking" took 21,500 crans off the market. Mr. John de G. Lacy, Fishery Officer, kindly gave me the number of barrels of "pickled' herrings, which are as follows:—Yarmouth and Gorleston 338,632; Lowestoft, 106,210—a total of 444,842 barrels. He also stated that "Klondyking"—packing of fresh herrings in ice—is still very largely confined to Lowestoft, in spite of the efforts of the Yarmouth authorities to foster it. About 140,000 crans were shipped from Lowestoft to Altona, mostly in boxes, and 25,500 from Yarmouth. It will be interesting to watch the progress of Klondyking during the next Fishing, at Yarmouth, for which process a notable extension has been made at the Fish wharf. Rivalry between the two herring towns in the past led to disputes that ended in blood-shed; to-day it is a matter of good-tempered rivalry.

GENERAL REMARKS

With the decrease of wooden vessels, those employed in certain trades, such as block-makers, rope-makers, and black-smiths have diminished in numbers. Coopering, on the other hand, has vastly increased, and box-making has become a thriving industry.

An interesting feature is the import of fish-salt, 22,000 tons having been brought in by 22 steamers. Some of this was brought from Runcorn and Weston Point, but the bulk of it came from the Balearic Islands.

Cargoes of barrels and wood for local barrel factories made for busy scenes on the quays.

The introduction, and increasing use, of wireless at sea have increased the safety of the fishing vessels, by giving warning of approaching gales.

Loss of life was exceedingly small, one Scotch fisherman having been drowned in the harbour when attempting to board his vessel. A Buckie boat sprung a leak and was lost on November 5th; another from the same port was lost a few days later, the fishermen in each case being rescued. During a severe storm a Peterhead drifter was 36 hours towing a disabled Buckie boat a distance of 38 miles.

It may be worth while making reference to the declining popularity of the kipper, a very tasty table dainty when

properly smoked, which was invented some years ago by the head of the Woodger family. Many of the fish-curers have failed to keep up to the high standard of smoke-cure set by the Woodgers, and the trade has suffered in consequence. The latest blow to this excellent method of cure has been the introduction of colouring matter and a hasty method of smoking hardly worth the name. In some cases I have suspected, from experiment at the tea-table, an inferior class of fish, as regards condition and freshness; while a superfluity of salt has made a very unpalatable article. Much complaint was also made of unscrupulous bloater-curers who used—and I fear still use—coke fires instead of oak billet-wood, in bloatering the herrings.

It was for a long time the practice of unscrupulous costers to purchase the unfit "black" herrings from small fish-curers These they made into small bundles around which a bit of old herring net was tied. Their methods of selling them to excursionists going along the quays to Vauxhall station were as unsatisfactory as their wares; but the opening of small fish shops on this route has done much to oust these undesirables.

VI

THE FUNCTIONS OF A LOCAL NATURAL HISTORY SOCIETY

By Robert Gurney, Prof. F. W. Oliver, Dr. E. J. Salisbury, and T. C. Blofeld

I. By R. Gurney

It is easy to say that the main functions of a provincial natural history society publishing Transactions, such as our own is, should be the investigation, recording and preservation of the fauna and flora of the County. Our Society has a record of work done of which it has every reason to be proud, and our Transactions contain a rich store of information on every aspect of the natural history of the County, much of it of great scientific value. On the other hand this work is the product of a very small minority of the members. There must, of

course, always be a large proportion of members who have neither the time, the training, nor the inclination to do any scientific work themselves, however much they may be interested in the work of others; but there probably are, or at least there ought to be, a considerable number who could undertake some work, especially if definite suggestions could be made to them of the lines on which they might do it. In making the following suggestions for work in fields with which I am not myself familiar I am guided, not so much by any positive knowledge that these are problems which require solution, as by the fact that they are questions on which I have sought information without success. It may often be profitable to retread old paths of research and to verify anew that which has already been observed; while that which has the freshness of discovery to one will surely prove a novelty also to many of those to whom the results are communicated.

These suggestions, which were discussed at one of our meetings, have been submitted to Prof. Oliver for criticism. The thanks of the Society are due to him and to Dr. Salisbury for their additional suggestions and comments.

As regards the eventual publication of results in our Transactions one difficulty arises. While on the one hand we must avoid what is trivial or of merely transient interest, it is not advisable that work of wide and serious interest should be published in a periodical of limited and local circulation. Nothing is more galling to a scientific worker than to find a reference to an important paper on his own subject in a periodical to which he cannot obtain access. In particular no descriptions of new species should ever be so published.

The suggestions I have to make myself are as follows:—

(1) Two species of the molluscan genus *Clausilia* are recorded for Norfolk, one of them simply as "common." I have found one of them quite common in West Norfolk; but I have never seen it in East Norfolk, and it would seem that the genus is not evenly distributed. It would be of interest to obtain a really thorough map of its distribution in the County together with detailed notes of the kind of situation in which the two species are found. The genus is easily recognised, though probably the species are not. Those who are not able to give time to make themselves acquainted with the

species should collect specimens from each locality in which the genus is observed and forward them, together with their notes, to someone who will act as referee and recorder. The Rev. F. W. Nevill (Old Catton Rectory) has kindly undertaken to name specimens submitted to him.

A mere record of the occurrence of *Clausilia rugosa* in the County of Norfolk, or indeed in a few localities in Norfolk, is of little or no scientific value; but, when our knowledge of the distribution of the genus approaches such completeness that we are able to say that a species does *not* occur in a certain area or in certain surroundings, we are getting very much nearer to a solution of the general problem of local distribution not only of the genus *Clausilia* but of other terrestrial animals too. Such a work might take years to complete, but it should be valuable if conscientiously done.

(2) The Woodlice of Norfolk have never yet been worked at, and it would be interesting to obtain an accurate knowledge, not only of the species which occur, but also of their distribution within the County. A good text-book of them has been published (Webb & Sillem. The British Woodlice. London, 1906) which makes their identification fairly easy.

(3) Anyone who has visited the Bure and the Yare valleys in summer will hardly fail to be struck by the dissimilarity of the flora. *Thalictrum flavum*, to mention one plant only, grows abundantly on the Yare marshes, but not at all on those of the Bure as far as I am aware. I do not know of any thorough treatment of this subject, certainly not at the hands of a Norfolk botanist. Miss Pallis has dealt with it to some extent (Types of British Vegetation, 1911), but it should be possible for members of our society to take it up and to establish first the extent of the difference, and then the nature of the causes. Here is a case in which team-work is specially called for. Dr. Salisbury points out (p. 312) the difficulty of organising such work, but its success when so organised is finely shown by the publications of the Blakeney Point Laboratory under the direction of Prof. Oliver. Another example of ecological botanical work which has been fruitful of results is that of Dr. E. P. Farrow (Journ. of Ecology, III. p. 211, 1915) on the Breckland flora and the influence thereon of rabbits.

It seems to me that it would be of interest if someone would

undertake to survey the grass- and marsh-lands of our river valleys with a view to ascertaining by local enquiry which of them at one time grew corn, and how far conditions have changed, as a result of drainage, etc., since those days. Such a record, simply as a record, could not fail to be of value, since such information is probably still obtainable, but will be lost with the passage of a few more years. Some of these marshes were broken up and planted with oats during the War—what has been the result ?

(4) Grigor's " Eastern Arboretum " was published in 1841 and gives an account of all notable trees then standing in the County. It would be well worth while to seek out these trees, to record their fate if they are gone or their growth if they still live, and to add notes of any specially fine trees which were overlooked by Grigor or have grown into prominence since his time.

(5) In Bentham and Hooker's British Flora (1900) one species only of the Water Buttercup is admitted under the name of *R. aquatilis:* but the London Catalogue of 1908 recognizes 10 species, and the Cambridge Flora (1920) includes nine. These species are difficult to discriminate and, so far as I know, no effort has been made to test their "specificity " by experiment. There should, one would think, be a fruitful field for research in this direction. Do such species when grown experimentally under conditions in which they do not normally live retain their specific characters ? The late Mr. A. Fryer did much to unravel the tangled nomenclature of the genus *Potamogeton* by growing the plants in his own ponds, and the same sort of work might be undertaken for the genus *Ranunculus.*

An accurate working out of the distribution of the species in the County would itself be valuable For instance *R. drouettii* is said to be " locally common " in Norfolk—what exactly does this mean ? What are the conditions which determine the presence of *R. heterophyllus* and the absence of *R. drouettii ?*

(6) Our knowledge of the fresh-water mollusca of Norfolk is very defective. It would be valuable if the Broads could be systematically worked, so that it was possible to draw up *complete* lists for each broad and section of the rivers and to compare them, with special reference to their salinities, etc.

One would then have a basis for comparison with other river systems, and a thoughtful analysis of such data would be a valuable contribution to the Transactions. Another direction in which such data would be of use would be in ascertaining to what extent our rivers have retained a fauna derived from connection with the old Rhine system, and how far such differences in the molluscan fauna as can be shown to exist between our rivers and the rivers of the west, for example, can be explained as a result of past history. The question of the relation of the eastern rivers of England to the Rhine system has been raised again recently by Prof. J. W. Gregory (Geog. Journ. July 1927). A valuable contribution to the solution of this problem would be a statement of the evidence which at present exists and the direction in which new evidence may be sought.

(7) Here and there in books on Norfolk references may be found to coast erosion and the loss of churches and villages, but I have never seen any connected history of the coast worthy of the subject. There is much information available in the records of the Sea Breach Commission, from which it would be possible to write a fascinating story of the struggle against the sea. The conditions in the river valleys when the sea poured without hindrance through the breaches in the sand-hills are illuminated by such stories as that of a marsh-man who sailed his wherry from Potter Heigham to Martham over the marshes without touching anything but the tops of the litter stacks.

(8) Finally I would point out that there are many small problems which obtrude themselves on anyone of an enquiring disposition and to which an answer cannot easily, or perhaps at all, be found in literature. For instance what is the rate of growth of the Yellow Water-lily? Seedlings without trace of root-stock abound in autumn, and the smallest plants with rudimentary root-stock must be in their second year; how old then must be those plants with root-stocks five feet long! Again who knows the rate of growth and duration of life of the fresh-water Mussel? Why are the paper-thin young so rare? Can the age of a mussel be told by its lines of growth? There is much literature on American mussels, which are of economic importance, but I know of none about our English species.

I should imagine that a fascinating subject for enquiry would be the life-histories of insects, but do not know how far this field has already been explored. Still, it does not follow that, because a subject has been written about, it is thereby exhausted. I have myself recently found much pleasure in searching for the larvæ and pupæ of the beetle *Donacia* on the roots of various water plants. The life history has been fully described by Böving, but that has not lessened the interest of discovering it anew for myself.

I have deliberately omitted certain lines of work which occur to me, such as the plankton of the Broads and its relation to salinity and so on, since this is a subject only to be dealt with satisfactorily by one who is not only a skilled systematist but also something of a biochemist as well. It is not particularly difficult nowadays to ascertain the composition of plankton, but it is unlikely that such work of itself would be of much interest in our own area, and no general conclusions could be reached without a study of the biochemical factors. One does not wish to add to the appalling accumulation of undigested facts under which Limnology is being submerged.

2. By Dr. E. J. Salisbury

The ideal activity for a local Natural History Society would be a co-operative effort in which members who were specialists in various departments would, either in the capacity of directors or referees, assist the more generally equipped to investigate the ecological relations of some naturally defined area. Such an ideal is, however, usually incapable of realisation for various reasons. Firstly, because for most members of Natural History Societies the study of natural phenomena is a leisure time occupation, a relaxation from other and often onerous duties. As such it is natural and proper that inclination should be a guiding factor in its pursuit rather than the necessity of fitting into a preconceived scheme. Further, the time available is irregular both in its incidence and amount, whereas a properly conducted co-operative effort demands observation at a given time and place. When to these difficulties is added the fact that the leisure of different individuals rarely coincides either in place or time, it will be realised that any effort at close

co-operation is as difficult as the mathematical treatment of a number of variables.

The direction, however, in which the activities of Natural History Societies have been most fruitful in the past and for which they are pre-eminently fitted, is in the accumulation and record of the data upon which the generalisations of the student of geography in its widest sense are based, and in the observation of biological phenomena.

It is to the Natural History Societies that we owe the raw materials out of which our local floras have been built, and although our knowledge of the distribution of flowering plants is fairly complete for many parts of the country, a great deal still remains to be accomplished in this respect in regard to the cryptogams and many of the less familiar groups of animals.

Conclusions respecting the relation between habitat conditions and geographical area cannot satisfactorily be based on one group alone, but should take cognisance of the higher and lower members of both the animal and vegetable kingdoms. At the present time, however, we are forced by our partial knowledge to rely for our geographical generalisations on a comparatively limited range of groups, but Natural History Societies could do much to broaden that basis by accumulating data with respect to those animals and plants whose distribution is as yet incompletely assessed.

Respecting biological phenomena much has been done with regard to the time of flowering of various plants, but even more important is the accumulation of other phenological data such as the dates of leaf expansion and leaf fall ; the average period of germination of the seeds of wild plants in nature ; the rate of spread either by seeds or vegetative means ; the rooting depth of species on different types of soils. All these and similar data require no co-operative effort and only demand accurate observation and care. They are thus especially adapted for record by those whose time for observation is variable in amount and intermittent. Each observation is, moreover, complete in itself, and therefore entails no liability on the further leisure of the individual.

Provided every care is exercised in their collection, such data are of great value in the study of competition and in assessing the rôle of individual species in the communities of

which they form a part. How much remains to be done in this direction can be gauged by the fact that it is probably true to state that the life history and biology is not completely known in the case even of the commonest British plant.

3. By Prof. F. W. Oliver

I am in general agreement with Dr. Salisbury's note on Natural History Societies, with one of which, as Secretary and then President, he has intimate knowledge. The membership must as a rule be too heterogeneous to co-operate closely in the field, in which respect they are less handy than parties of University Students who have a common outlook and discipline. Unless therefore, some Pied Piper of Hamelin should arise, the necessary wave of enthusiasm to move such a body will hardly be forthcoming. None the less, much useful work lies to their hand, of which a single example on the botanical side may suffice.

In the immediate future the British Ecological Society will be arranging for the preparation of an Ecological Flora of Great Britain, a work that may extend to the compass of two or even three volumes. This will concern itself more especially with the occurence, habitats, habitat forms, times of flowering, and life histories in general of British plants. By allocating the Norfolk plants among the membership everyone taking part would have a clearly defined task, and in the course of a season or two much information on the required lines should be forthcoming, all of which would find its place in the contemplated book. Very shortly, a printed specification of the kind of details required will be issued for distribution, together with a tentative draft or model example of what is intended for a single species. With these in hand and a certain amount of local organisation, the work should proceed smoothly, and so far as Botany is concerned, go some way towards filling the lacuna to which the Treasurer of the Norfolk and Norwich Naturalists' Society has drawn attention.

4. By T. C. Blofeld

As a result of a speech last year by Mr. Robert Gurney, it occurred to the writer that there was a large amount of at

present unco ordinated effort in the Society which might profitably be harnessed to deal with problems of scientific interest to commercial agriculturists and horticulturists. Research work on these subjects is nowadays at any rate, in its ultimate value, very largely dependent on the presentation of a mass of observations by a skilled worker well versed in statistical method. In order that such a worker may collect his data he must have working for him a fairly large number of observers, all in some degree scientists, all intelligent, and all capable of making and recording careful observations. Many of the members of this Society are observers such as I have described, and it is the purpose of this article to point out to them the fact that there is a deal of important work which they can do, and that there are plenty of trained men who would be grateful for such help and only too willing to co ordinate their observations if they were collected in sufficient number.

From the purely horticultural point of view there are numerous problems with regard to fruit trees which are eminently suitable for the semi-skilled investigator ; although, as with most biological problems, observations to be of any value must be made over a considerable period of time.

1. The colour of fruit, particularly of apples, and its variation with the composition of the soil and with other factors, is a subject of great interest. It is held that on certain soils the application of Potash will enhance the red colour of many dessert apples ; but this statement has not properly been investigated on soils of a craggy nature such as are to be found in Norfolk. From the practical point of view such an investigation should be of value, since on these soils the variety Cox's Orange Pippin will grow and crop fairly well, but will not produce, under ordinary conditions, apples of a very high colour. Colour in this variety, as in many others, is largely the determining factor of the price obtained for the apple.
2. The effect of thinning an apple tree in mid-June might be investigated with reference to the loss or gain in weight of apple ultimately produced, and the size and colour of the fruit. Experiments on pruning have already been carried out in great variety, and there is a considerable

mass of literature on the subject. By judicious reading and some practical knowledge it is frequently apparent that methods have not been pushed to their logical conclusion, in their effect, for a length of time necessary to a proper judgment of them.

3. From the point of view of general interest, of systematic botany and of agriculture, the plant population in different places is a subject of profitable study. Valuable information about soils can be obtained by comparison of the normal plant population of an area with that of similar ground which has been farmed for a great number of years and with again similar land on which definite dressings of particular fertilisers have been applied. A considerable amount of work has been done both on soils and on weeds and ideas for future work can be got from what has already been published. The reader is referred for suggestions to Hall & Russell's report on the soils of Kent, Surrey, and Sussex, and to Miss Brenchley's book on Weeds.

4. For anyone with a leaning towards Mendelism and genetics there is a great field as yet undeveloped in the selection of pure strains from wild, garden, and farm plants. An example may be taken from the Martagon Lily which has a rare white variety never yet established in its genetical composition. Sugar Beet and Winter Barley would both be eminently practical lines on which the geneticist could work.

This has only given a few suggestions which members might care to adopt. If they do, or if they can suggest other problems of interest to agriculture and horticulture which they are willing to investigate, I shall be glad to hear from them. They may be quite sure that in any investigation of value they can rely upon the advice and help of those men who are most capable of giving it.

VII

NATURE RESERVES

(Being a Report on the Conference of Delegates of Corresponding Societies at the Meeting of the British Association at Leeds, September, 1927)

By F. W. Oliver, F.R.S.

At the meeting of the British Association at Leeds the subject of Nature Reserves was brought before a session of the Delegates of Corresponding Societies. A general notice of this discussion had been given some months before, and Mr. Sheppard of Hull and I had been asked to speak on the subject. Unfortunately, the discussion which followed our opening strayed away from the subject of Nature Reserves in their general aspect, and it is doubtful if the discussion served any useful purpose.

Mr. T. Sheppard, in opening the discussion, said it had not been found necessary in Yorkshire to arrange officially for reservations, as there were many landowners who maintained breeding grounds on their own initiative.* He instanced the cases of Spurn Point, Hornsea Mere, and Flamborough Head. Reference was made to the species breeding in each locality, and details were given of the methods followed by cliff climbers at Flamborough to obtain eggs, especially in the case of Guillemots' eggs, which are in considerable request. I understood Mr. Sheppard to say that he estimated the number of eggs thus robbed from the cliff at 130,000 per annum, in spite of which the colony of birds undergoes no appreciable shrinkage. The Guillemots' eggs are sold at 1d. each, except those of unusual marking, which fetch 10s. or even £1 from collectors.

F. W. Oliver, in continuing the discussion, said that the subject of nature reserves was one to which delegates from all over the country could usefully devote some attention His remarks would apply especially to matters of organisation and administration, of which he had had some experience in the last twenty years. In the present state of changing England, and especially of the revolution in communications which petrol

* Thus, the National Trust have no properties in the County except Sharow Cross, near Ripon.

and the motor car had wrought, he supposed there would be general agreement as to the importance and often urgency of obtaining representative examples of natural ground with its flora and fauna, so that these might serve as a present enjoyment and solace, and might be handed down to future generations intact, with records of their changing history.

Already many such areas exist. The National Trust have secured a considerable number, as also have the Society for Nature Reserves, the Selborne Society, civic bodies like the Corporation of the City of London, and so on. They work independently with a certain amount of correlation, but no organic connection.

Reserves in Norfolk

As the representative on the present occasion of the Norfolk and Norwich Naturalists' Society, he thought the most useful contribution he could make would be to sketch in outline what had been done in the county in this matter, and then consider whether the experiences of Norfolk contributed anything likely to be useful in the solution of the general problems raised by nature reserves. As with Yorkshire, the county had landowners who paid regard to such amenities; nevertheless, in recent years there had been a decided movement in the direction of definite reservations. The beginning, so far as he knew, dated back to 1910, when the Lord Calthorpe of that day granted him a lease of Blakeney Point for purposes which were described as "marine horticulture." Two years later, on the death of Lord Calthorpe and the dispersal of the Norfolk estate, Blakeney Point was purchased privately and presented to the National Trust. The danger of its exploitation should it have fallen into unsuitable hands was thus avoided. Famous as the Point was as a place of call for birds on migration, and as it later became when the terns reorganised their breeding ground on land which in 1912 did not yet exist, it may be remarked that the effort which led to reservation came mainly from the botanical side. Enthusiastic birdmen viewing the breeding ground in its present flourishing state sometimes forget that the botanical interest of the area is second to none.

Next, following the War, an opportunity was found to assemble and reorganise a number of ill-supported birds

breeding grounds under one authority, the Norfolk Bird Protection Committee of the Norfolk and Norwich Naturalists' Society, of which Dr. S. H. Long, the moving spirit, became Secretary. The results of this work have been most satisfactory, as the increase of the birds cared for, and of annual subscribers, alike testify.

Scolt Head. A few years ago the extensive, beautiful, and faunistically and botanically most attractive area known as Scolt Head was offered for sale privately on generous terms. With the assistance of the local press the appeal for funds met with an instantaneous and enthusiastic response, so that within a few weeks the purchase price, as well as a nest egg for upkeep, were obtained. By a private benefaction, a well equipped hut was provided so that naturalists could reside and carry on their observations under the best conditions. This property also was handed over to the National Trust (1923).

In the opinion of the speaker the case of Scolt Head proved abundantly the existence of a fine local patriotism, capable of responding generously, and marked a definite step in the nature protection movement in the County.

Last year the Cley Marshes, formerly in the possession of the late Mr. A. W. Cozens-Hardy and well known as a sanctuary for many breeding birds and in winter as a sporting estate, were bought at public auction by Dr. Long and a group of ornithologists. As there were good reasons why it was not convenient that this property should pass to the National Trust, with the approval and encouragement of that body Dr. Long founded a special, non-profit-paying company or association under the Board of Trade, to administer it under the name of the Norfolk Naturalists Trust, with powers to acquire or take over other areas. Membership, by annual subscription or payment of a lump sum, has secured a balance of the order of £1,000, so that this Trust is in a position to advance in other directions. Special attention was drawn to the Articles of Association and regulations of the Norfolk Trust which are drafted in a broad spirit, and are more flexible and perhaps more far-reaching than those of the National Trust itself. Certainly the future history of this Trust should be well worth watching, with a view to the application of similar schemes

in other localities. It seemed to the speaker that by this act Dr. Long had perhaps gone a long way towards the solution of the problem of organisation. It had provided a territorial basis, with the county as the obvious unit. With the aid of the local press, by lectures, meetings, excursions, and other propaganda, the county can be kept informed of the general progress, and its enthusiasm aroused when some fresh sacrifice is required, and this in a way quite impossible in London.

If the enterprise succeeded one would look forward to the time when every county would have its County Trust, which would hold and administer the areas it acquires.

Norfolk, no doubt, was favourable ground for such an experiment in view of the traditional and widely diffused devotion to natural history pursuits, combined with a strong local patriotism; moreover, the county is happy in being able to act as one unit, and not as two or three, as in districts where local jealousies or antagonisms exist. At the present moment perhaps the number of counties ready to take such action is limited, but here we seem to have the germ which may lead to far-reaching results. Should the idea catch on possibly an Act of Parliament might be promoted which would ease the way for such Trusts by creating a simple and inexpensive machinery.

As regards the National Trust itself, there seems no reason why it should not welcome the devolution which County Trusts would mean. Already in very many cases it gives to its local committees of management a very large measure of independence, and one might even look forward to a time when many of the properties now held by the National Trust could be handed over (or at any rate leased) to the County Trusts, so soon as they qualify by work done and financial stability. This delegation of functions would leave the National Trust more free to act as a correlating and advisory body, and to represent the movement in the Metropolis. Ultimately, the relation between the parent body and the County Trusts would have to be defined, and this might perhaps include the reservation of a right of veto for the National Trust. That was the speaker's notion, but it was a purely personal view. The great thing at the moment was to get the idea of County Trusts ventilated in the various districts represented by the delegates.

As regards finance, it was evident that those interested must expect to spend money—sacrifices would undoubtedly have to be made. It was not to be expected that grants from Town and County Councils, or from the National Exchequer, would immediately flow in, but later, should the movement make good, these might come. The more widely the financial burden can be spread the better, and the more likely to accrue are substantial subscriptions from rich and generous people. It would also be desirable that County Trusts should accumulate a useful balance, so as to be able to purchase swiftly when opportunities arise.

Classification of Areas.—A distinction has to be drawn between two separate requirements :

(1) The preservation of the amenities of growing cities—the advance of bricks and mortar ; Where would London be without Epping Forest, Richmond Park, Windsor Forest, and its numerous heaths and commons, such as Wimbledon ? These should be especially the province of civic bodies rather than the societies such as the conference represented, though we do well, no doubt, to keep touch and help in guiding such efforts.

(2) The preservation of the country and especially such parts as are threatened by new transport facilities, week-end bungalows, trippers, and the like. But we are not restricted to such places, for no one can foresee what will happen next.

A County Trust will consider areas representative of the county as a whole, and among these will be some of national importance, likely to attract visitors from all over the country and perhaps from abroad. Such " star " areas are not always easy to recognise off-hand—the difference between the *good* and the *very good*, though real enough, is rather subtle, and considerable experience and judgment will be called for.

There is much to be said for the occasional large area, and for this reason. Small areas in time advance by natural processes to another phase ; scrub becomes forest, fen becomes dry land, mobile dynamic areas become stabilised, sand dunes change their character, etc. This is inevitable and unavoidable, and the only remedy is to have areas large enough to provide new juvenile phases as others pass into older stages. Botanists, zoologists,

bird and insect men, are all equally affected by these changes ; habitat, vegetation, and fauna are all inter-related.

Uses of Reservations

They should be used as places of study, and, at the least, proper scientific, but not too technical, accounts of their features and resources should be made available.

Where possible, areas should be accessible to the general public, as well as to qualified naturalists. Properly shown and explained, they will have a very great educational value, and a healthy public opinion on such matters will be promoted.

Ultimately, every considerable natural history society should aim to have a reservation as its playground. It will be concerned with the following: administration, description, observations and records, research and experiment, propaganda and intelligence, and, as adjuncts, a museum of illustration and a reference library. It should be an obligation to use such areas properly to justify the annexation—otherwise it is hard to resist a frequent criticism of country folk, that it is only one more whim or vice of the idle rich, like game preserving ; that it means some curtailment of their liberties and should therefore be resisted.

Finally attention was called to a great desideratum, a journal (perhaps monthly), edited and produced in the best manner possible, and giving publicity to the movement and cultivating a good public opinion.

VIII

SOME EFFECTS OF THE CLOSURE OF THE NORTH SEA TO FISHING DURING THE GREAT WAR AND OF THE RESUMPTION OF FISHING

By D. E. Thursby-Pelham

The scientific history of the Great War of 1914-1918 has yet to be written in full. There can be no doubt that the immense increase in the amount of energy that was directed towards scientific experiment has had, and will continue to have, a very lasting effect on the future of the world. While the majority

of experiments were definitely planned, many were entirely involuntary, and of these there can have been no more gigantic experiment than the closure of a large part of the North Sea to fishing during the greater part of the period.

The extent of the closure was shown by charts issued by the Admiralty to fishermen during the war; roughly only a strip of the North Sea was left open, from Kinnaird Head to the Wash, and part of this was closed Mine fields were a constant danger to the fleet, who fished towards the end of the war under the protected convoy system; before this was instituted many fishing vessels were lost. In addition to this curtailment some 3,000 fishing vessels were employed by the Navy for mine sweeping and other purposes, not only in the North Sea and round the British coasts, but also many went out to distant waters—the White Sea, the Adriatic, Suvla Bay, etc.—the losses both of ships and men were very heavy. On the eastern side of the North Sea fishing was confined to coastal waters in the vicinity of the belligerent and neutral countries.

It is difficult to estimate precisely the reduction in the total quantity of fish landed, compared with the average quantity taken before the war, since the statistics were not kept by some of the foreign countries and this article will be confined, therefore, to the figures afforded by the statistics of Great Britain.

Since Great Britain accounts for some 60 per cent. of the landings of fish, other than herring, from the North Sea, the figures give a very fair picture of the condition of affairs. This account, again, will only treat of "Demersal" fish, roughly those which live on or near the bottom of the sea, which are largely taken by the trawl, and not of "Pelagic" fish, such as the herring, mackerel, sprat, etc., which are principally captured by drift nets suspended in the upper layers of the sea.

The average quantity of demersal fish brought to port in Great Britain in each year during the years 1907-1913, was 3,857,021,000 cwts., and that of the last two complete years of fishing before the war, 1912-1913, was 3,504,273 cwts. From 1914 to 1918 only 8,454,285 cwts. (approximately) were landed, or an average for each year of 1,690,857 cwts. Therefore some 9,067,080 cwts., which would amount to many

billions of fish, were left in the sea by English vessels alone, which would otherwise most probably have been captured.

It was held by many authorities that man had no power to influence the productivity of the sea. The famous Belgian Naturalist, Van Beneden, laid down the principle that " The fecundity of fish is so great, the quantity of immature fish so small in comparison with the immensity of the sea, that it does not matter where or when the fishing is carried on or with what engines, man is unable to disturb the equilibrium which the Creator has established between destruction and reproduction—between life and death." The principle was held by Professor Huxley and the Government Administrators as far as the drift-net fishery and the cod fishery as then carried on chiefly by means of hooks and lines were concerned, some fifty years ago, and fortunately led to the abolition of many obsolete regulations which were imposed through ignorance of the life histories of fish. At the same time Professor Huxley admitted the possibility of the trawl-net fishery affecting the fecundity of the sea, though he has often been misquoted with regard to this point. The view that fishery of any kind has no effect is still held by Professor McIntosh, and is frequently quoted by those who are opposed to regulations proposed for the improvement of the Fisheries. It is difficult to see how this view can now be maintaned when it was proved that after the war the sea was able to support nearly twice as many fish as had been allowed to grow to maturity before the war.

The question naturally arises, how do you know that there were more fish in the sea ? To answer this it is necessary to explain the methods adopted by fishery research workers.

The actual abundance of fish cannot be judged accurately by the landings, since these, to some extent, depend on economic factors such as the demand, the possibilities of transport, the number of vessels fishing, etc. The Ministry of Agriculture and Fisheries has Collectors of Statistics at each port, who find out where each vessel has been fishing, and the amount of the catch of each kind of fish. Their returns are tabulated and are entered on charts of the North Sea, which are divided at the present time into rectangles of one degree of longtitude and half a degree of latitude. Up to 1920 it was divided according to depths. Since the average length of each voyage

is known, it is possible to calculate the average catch of each type of vessel in each part of the North Sea, either according to "the day's absence from port" which was the standard used till recently, or "the catch per 100 hours fishing" which has been calculated during the last five years. It is obvious that according as to whether there is a greater or lesser amount of fish available for capture in the sea, the catch per days' absence, or per 100 hours fishing, will rise or fall. Different types of vessels have, as might be expected, differing catching capacities, and for our purpose of estimating abundance the catch of the first class steam trawler will be used, since this type of vessel lands 83 per cent. of the English North Sea catch of demersal fish.

The steam trawler catch per days' absence varied from 16.6 to 18.3 cwts. in the years 1906-1913. The mean catch of these years was 17.2 cwts. When fishing was resumed after the war it rose to 31.1 cwts. in 1919. The following table gives the

Catch per days' absence of Steam Trawlers in certain Years in the North Sea.

	1912	1913	1919	1920	1921	Mean 1912-13	Mean 1919-21
Haddock ...	4.69	2.99	15.84	10.91	9.70	3.84	12.15
Cod	4.45	4.40	5.18	5.58	5.04	4.41	5.27
Whiting ...	1.72	1.89	1.86	1.71	1.56	1.80	1.71
Hake	0.03	0.03	0.02	0.08	0.12	0.03	0.07
Ling	0.16	0.16	0.14	0.19	0.22	0.16	0.18
Coalfish ...	0.35	0.52	0.38	0.45	0.34	0.43	0.39
	11.40	9.99	23.42	18.92	16.98	10.07	19.77
Plaice	2.34	2.09	4.53	3.42	2.57	2.22	3.51
Soles	0.09	0.08	0.18	0.27	0.30	0.08	0.25
Halibut ...	0.03	0.02	0.02	0.02	0.02	0.02	0.02
Turbot ...	0.24	0.23	0.50	0.55	0.46	0.23	0.50
Megrims ...	0.03	0.03	0.00	0.00	0.01	0.03	0.00
	2.73	2.45	5.23	4.26	3.36	2.58	4.28
Total Demersal Fish	17.7	17.3	31.1	25.4	22.8	17.5	26.4
No. of days' absence ...	142,524	147,301	92,551	163,599	139,400	144,912	131,950

details of the catch per days' absence of the total demersal and of the more important fish. The number of days' absence from port of the vessels is also included lest it be argued that the decrease or increase depended entirely on whether there was a greater or lesser amount of fishing. This may have been

the case to some degree in 1919 when the fishing was below the pre-war standard, but since, in that year, the area of the operations of the fleet was still restricted to a considerable extent by the presence of mines, this is more apparent than real. Moreover, it does not account for the increased abundance in 1920 when the fishing had more than regained the pre-war intensity.

With the exception of haddock, the round fish show but little difference from the pre-war abundance, and that of whiting was rather lower in 1919 than in 1913. The figures of whiting, however, are not indicative, to all probability, of the actual takings, since this fish is of a low monetary value and, being human, the fisherman is apt to throw it away when he is getting a large quantity of more valuable fish, since it would tend to fill up the fish-hold with little profit. Haddock, again, must not be taken too seriously as it is always subject to violent fluctuations, probably due, according to the Scottish authorities, to the influence of good and bad years for the development of the eggs and larvae. It can be stated, however, that on the whole the average size of the round fish was much larger than before the war.

It is when we turn to the flat fish that the increase is really remarkable. The three most important flat fishes to the North Sea fishermen—plaice, sole and turbot—were twice as abundant in 1919 than they were in 1912 and 1913, and though the catch per days' absence in 1920 fell, roughly, a million cwts. more were landed in that year than in 1913.

From investigations carried on during the past twenty-five years it has been long evident that the flat fish are the most affected by the operations of man. Sole and turbot have not been studied to any great extent, but the life history and abundance of plaice have been the object of much investigation both in this country and by the fishery scientists of the other side of the North Sea, who have worked on concerted programmes under the auspices of the "International Council for the Exploration of the Sea." Since more is known about the plaice than any other fish, it will serve best to illustrate the effects of fishing. It is not, however, in quantity alone that the plaice showed so great an improvement in the immediate post-war years, the quality was infinitely superior. Before

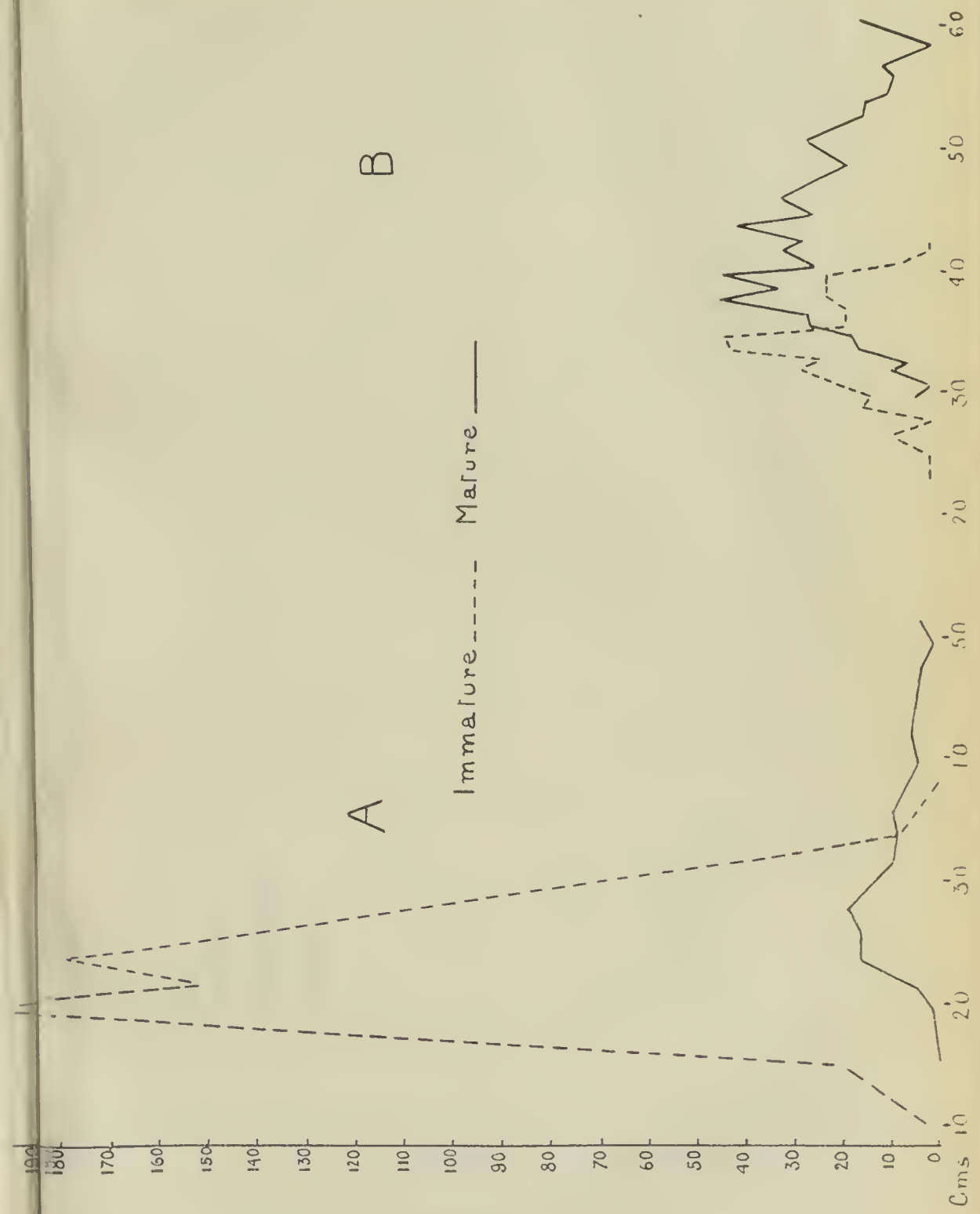
A
B
Immature----- Mature ——
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DIAGRAM 1

the war the vast majority of plaice caught in the southern North Sea was immature ; after the war the reverse was the case. This is illustrated in the accompanying diagram which shows the proportion per 1,000 fish of immature to mature in the Flemish Bight. A is from samples taken in the years 1907-1908 and B in 1920.

The difference is so striking as to make further comment unnecessary.

The statistics of the Market Categories " Large," " Medium," and " Small," show that the proportion per cent. of each category for the mean of the years 1906-1913 was " Large " 23.5 per cent., " Medium " 28.9 per cent., " Small " 42.4 per cent. and " Unsorted " 5.2 per cent., while in 1919 and 1920 respectively 37.8 and 41 per cent. were of the category " Large," 54.3 and 37.6 per cent. of " Medium " while only 7.5 and 14.8 per cent. were of " Small." These figures refer, of course, to the actual landings after any that were too small for the market were rejected on board ; measurements made on board commercial vessels are more strictly reliable since, not only do they refer to the whole catch but they have not been subject to alterations in the methods of sorting. The following diagrams of the proportion per cent. of each 5 centimeter group

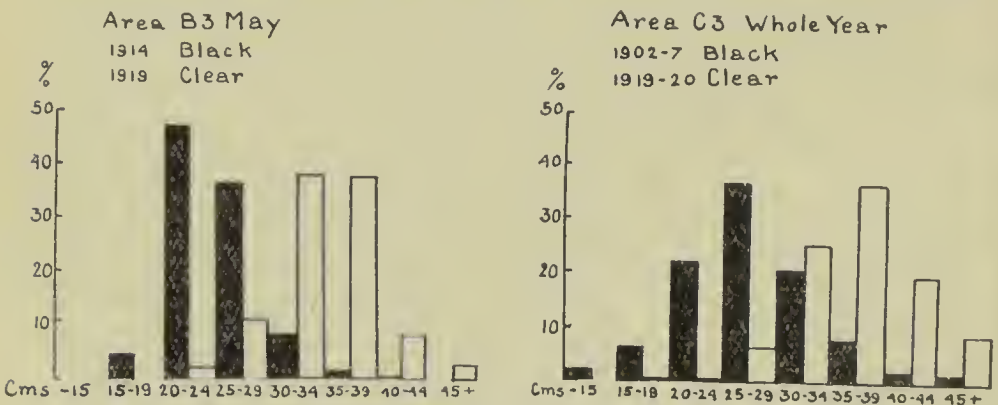

DIAGRAM 2 AND 3

taken from measurements made in two parts of the principal plaice grounds of the Southern North Sea (Areas B3 and C3) show the differences more exactly.

It will be noticed that while in May in B3 the majority of the catch in 1914 were between 20 and 29 cms, in 1919 the majority were between 30-39 cms ; the groups of the smallest fish, 15-19 cms, were not represented at all, and a very small proportion was in the 20-24 cms group.

C3, the principal spawning area of the plaice, where any big fish that may be present in the southern North Sea congregate during the winter for spawning, shows much the same picture. The average size of the plaice stock was 10 cms higher than before the war. The reasons for this are evident, the diminished fishing had given the fish the opportunity to grow up.

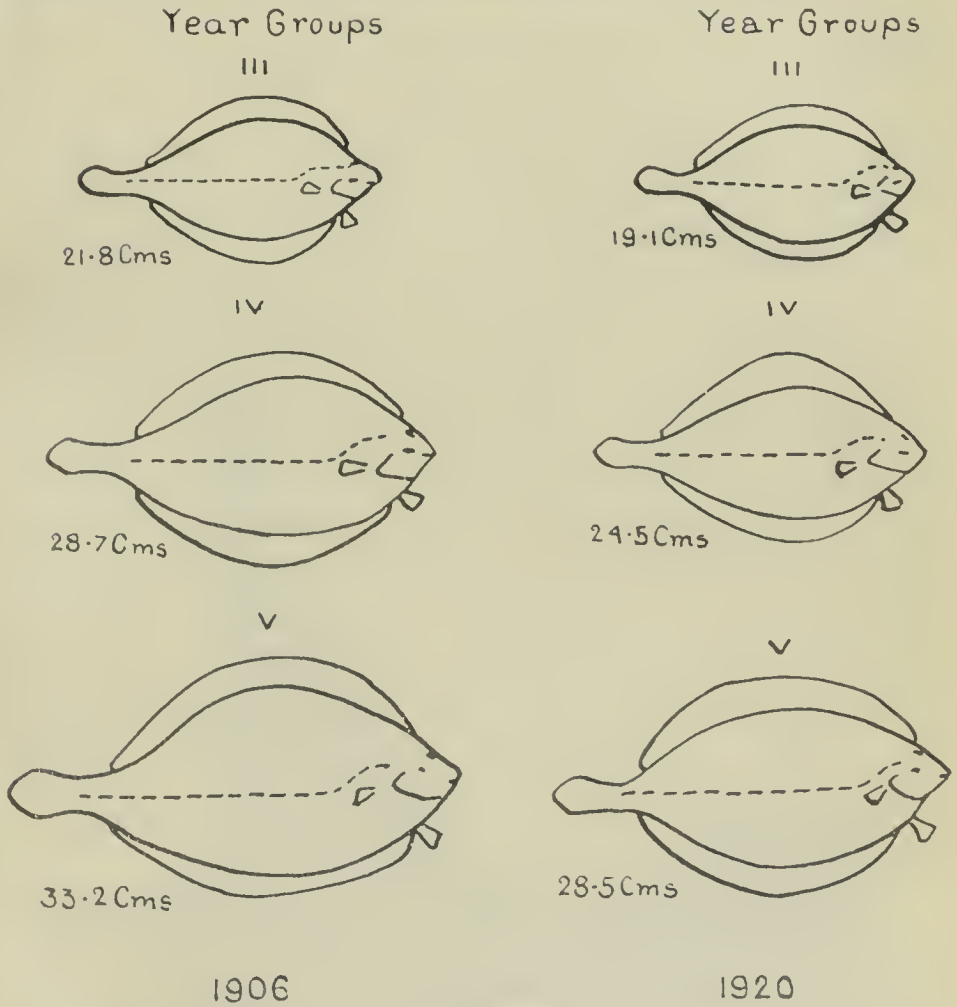

DIAGRAM 4

There was, however, a certain disadvantage connected with this immense accumulation of the older and larger fish, which was shown by Dr. Wallace in comparisons between the rate of growth of the pre-war and post-war plaice. He showed that the growth rate had slackened in the southern North Sea and that plaice of the same size were nearly a year older in 1920 than they were in 1906. This is shown in the accompanying diagram of the average length of the III. IV. and V. year groups of female Plaice in the two periods.

The following table shows the difference more exactly. It, and the diagram, are taken from samples trawled along the line of the outward spring migration from the Haaks Light vessel off the Dutch coast to the Leman ground.

AVERAGE AGE AT CERTAIN LENGTHS

Length in cms.	20	21	22	23	24	25	26	27	28	29	30
Males											
1906 ...	2.9	3.1	3.0	3.1	3.3	3.4	3.5	3.8	4.0	4.1	4.2
1920 ...	3.4	3.2	3.2	3.6	4.1	4.4	4.6	4.5	4.9	5.3	5.9
Females											
1906 ...	2.8	2.8	3.0	3.1	3.2	3.2	3.5	3.9	3.8	4.0	4.0
1920 ...	3.4	3.8	3.9	4.0	4.0	3.9	4.7	4.6	4.9	5.0	5.4

The younger plaice, moreover, were not so far offshore as they were before the war, and the explanation given was that they were banked inshore owing to insufficient food available offshore, due to the presence of the enormous stock of older fish, and that being overcrowded, they had not enough to eat to enable them to grow rapidly. This would also account for the absence of the very small plaice in the catches in B3 and C3. Whether or no this was the whole story is now somewhat open to doubt, since subsequent investigations on the age and growth of plaice tend to indicate that other factors may play a considerable rôle in the growth rate.

This slackened growth rate was not common to the whole North Sea. Transplantation experiments made in 1920 to the Dogger Bank showed that there the plaice increased in size as rapidly as before the war despite the fact that the abundance was twice as great.

A still further effect of the increase of the mature plaice was shown by English and German investigations on the number of plaice eggs spawned in the great spawning area of the Southern Bight. It was estimated that the number of eggs spawned in 1920 was more than twice that of 1914.

Subsequent History

The prospects of the North Sea fishermen were very bright in the years immediately after the war. The sea was teeming with fish of large size and of high value. Large quantities of money were invested in fishing and the number of vessels increased rapidly. For three or four years all went well, then came the decline. That this was swift and great is shown

by the following figures for the average catch in cwts. per days' absence by steam trawlers.

	Cod.	Haddock.	Plaice.	Soles.	Turbot.	Total Demersal.
1913 ...	4.4	3.0	2.1	0.1	0.2	17.3
1919 ...	5.2	15.8	4.5	0.2	0.5	31.1
1920 ...	5.3	10.9	3.4	0.3	0.5	25.4
1921 ...	5.1	9.6	2.5	0.3	0.5	22.8
1922 ...	3.9	8.5	2.2	0.3	0.4	19.5
1923 ...	2.5	5.4	1.9	0.2	0.3	14.2
1924 ...	2.6	4.8	2.1	0.2	0.3	14.5
1925 ...	3.5	8.5	2.3	0.1	0.3	18.4
1926 ...	4.2	8.2	2.3	0.1	0.2	19.4

Plaice, which, as already stated, were the most affected by the closure, were the first to show the effect of the resumption of fishing. The following diagram makes the extent of the rise and fall in abundance clear.

DIAGRAM 5

In 1923 the average catch fell to below the low level of 1913 and, although it rose during the last two years, it cannot be said to be satisfactory. There is certainly no numerical scarcity of plaice in the sea, but the average size of the fish has fallen to the pre-war level. The proportion of each trade category for the last seven years is as follows :—

	Quantity in Tons.			Proportion per cent.			
	Large.	Medium.	Small.	Large.	Medium.	Small.	Unsorted.
1920 ...	13487	12377	4880	41.0	37.6	14.8	6.5
1921 ...	6168	11047	5703	26.1	46.7	24.1	3.0
1922 ...	4750	9710	10518	18.7	38.2	41.3	1.8
1923 ...	3217	6088	12384	14.3	27.1	55.2	3.3
1924 ...	2329	4998	13516	10.5	22.6	61.2	5.7
1925 ...	1744	3566	16149	7.6	15.5	70.4	6.5
1926 ...	1264	3052	13808	6.6	15.9	71.9	5.6

It is very evident that the more valuable fish are very scarce and that there is a very large quantity of the more unremunerative sizes.

The measurement of plaice on board commercial fishing vessels has been continued on a large scale, from nearly two hundred to three and a half hundred thousand having been measured by the Ministry's staff in each year. The decline in size of the plaice caught has been continuous and the average size is now much the same as it was before the war. This is illustrated by the following diagram of the proportion

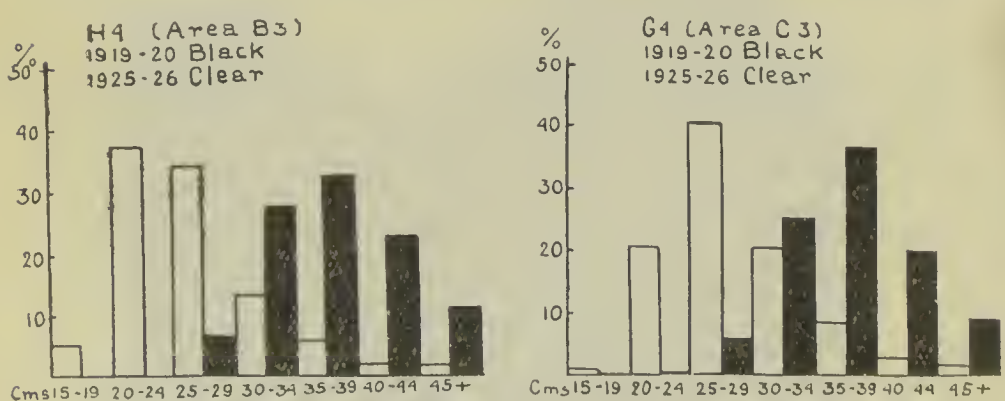

DIAGRAM 6 AND 7

per cent. of each centimeter group taken from samples trawled in the same areas as those shown in the previous comparison of pre- and post-war fish.

This, of course, only deals with a small section of the North Sea, but it is common to the whole of the main plaice grounds. The effect of the decline in size has been that many plaice are caught that are too small for commercial purpose and millions are thrown overboard either dead or dying in the course of the fishing. It is not the purpose of this article to enter into the commercial aspect, but at the same time it is of interest that the number of hours' fishing has dropped from 2,254,120 in 1921 to 1,950,881 in 1925, and that this decline is due in the main to less fishing in the regions where the plaice fishery is principally carried on.

Soles also show a decrease of the larger sizes; in 1920 the proportions of the trade categories were as follows :—" Large " 68 per cent., " Medium " 12 per cent., " Small " 16 per cent., and " Unsorted " 3 per cent. In 1926 the " Large " had fallen to 40 per cent. and " Medium " and " Small " had risen to 23 per cent. and 29 per cent. respectively.

To turn again to the growth rate of plaice. The line of stations from the Haaks Light Vessel to the Leman Ground, which have already been compared for the pre- and post-war growth rates, has been trawled in every year since 1922 by the Ministry's research vessel, and collections of otoliths of every plaice caught have been made. As we have already seen, the large fish have disappeared to a considerable extent. The young fish too have moved offshore, indeed they are found further out to sea than in 1906, but the growth rate still remains much below the pre-war level. What the causes of this slow growth may be, are as yet unknown. It is possible that it is still affected by the war in that there were more mature spawning fish, certainly up to 1923, than before the war, which might increase the number of plaice on the inshore grounds. Incidentally it may be stated, however, the winter of 1923 was evidently unfavourable for the development of the eggs and larvæ, as very few of that year-class are present in the North Sea in 1926. Nevertheless, on the whole, the catch of plaice along the line of stations was greater, numerically, from 1923 to 1926 than before the war, and although it has recently consisted of very small fish, the food supply may have been insufficient for a rapid rate of growth in this area. The plaice of the eastern grounds north of Heligoland, as shown by German investigations, and

by the English research work carried out in the early summer and late autumn of 1926, showed a rapid growth, and as far as can be judged by the somewhat sparse data of the English, Danish, and German investigations, were more abundant than on the grounds off the Dutch coast. This would lead one to suppose that other factors besides overcrowding have considerable influence.

The whole question of the causes affecting the growth rate are still conjectural and many causes may be at work. For example, it may be influenced by hydrographical conditions causing fluctuations, not only in the development of the fish but in the supply of food available ; or by competition with other species which eat the same food, such as the haddock, which, as we have already noticed, is subject to violent fluctuations. Recent work tends to show the matter is one which requires further research.

To elaborate further the effect of the cessation and resumption of fishing would be tedious. Should anyone wish to study it in greater detail they can refer to the Ministry's publications on the subject in the accompanying list. The paper published by Mr. J. O. Borley and the present author in 1925 gives a comprehensive bibliography.

Enough has been said to give an outline of the changes in abundance and size of the stock of the principal flat fish. The effect of natural fluctuations have not been dealt with, and although recent investigations have thrown some light on these, in the case of the plaice they tend to prove that while the productions of the young stock may vary from year to year in amount, they have not so far-reaching an effect as the agency of man.

The reason for the omission of the effect of the war on the herring must be given. The quantity of herrings fished for and landed is almost entirely an economic one. The great majority of herrings caught are not consumed in this country but are salted and exported to Russia, Germany, Poland and other countries. When, as has been the case in recent years, the demand has diminished owing to the unsettled financial conditions, a very much smaller quantity of the fish caught is saleable. It is therefore impossible to say whether the war resulted in an increased supply. The

export of herring at the present time is still below the pre-war level.

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IX

WILD BIRD PROTECTION IN NORFOLK IN 1927

Report of the Committee

Although, from a climatic point of view, 1927 was one of the worst summers experienced in Norfolk for very many years, yet, from the point of view of wild birds (excepting game-birds), the effects upon reproduction were not nearly so disastrous as might have been expected. Birds nesting on exposed foreshores are always subject to unexpected dangers in the shape of high tides, gales of wind, etc., but this year very few nests were washed out on the Norfolk terneries; and although there was an almost unprecedented amount of wind during the period of incubation, the blowing sand, one of the deadliest enemies to terns' eggs, was, owing to the excessive rainfall, a factor of no very serious import.

For purposes of classification, birds of Norfolk may be divided into: (1) Shore birds; (2) Broadland Birds; (3) Upland birds; (4) Breckland birds. As regards the first the committee has their protection during the breeding season well in hand, and the two principal nesting areas on the coast, namely, Blakeney Point and Scolt Head Island, have been secured as Nature Reserves for all time.

Perhaps the most important district in the county, from the point of view of rare nesting birds, is Broadland. Here the Committee has no direct control, nor, indeed, is any such needed so long as the ownership of this part of the county remains in the hands of as good naturalists and sportsmen as at the present time.

As regards what may be called the Upland birds, there are so many commons, parks, and other enclosures in the county, and such a plentiful food supply for all seed-eating birds in the arable fields and gardens, that there is no fear on their account. But, for the fate of the Stone-curlew in Breckland, its chief stronghold in England, the Committee has anxiety. From the recent correspondence in the "Times," it will have become widely known, how, by their planting, the Forestry Commissioners are entirely altering the face of this part of Norfolk, and

unless a considerable area—at least 1,000 acres—can be secured and allowed to remain as uncultivated breckland, it is only a question of time before the Stone-curlew is driven, as was its larger relative, the Great Bustard, from those glorious heaths to which for untold centuries it has so regularly returned to nest. Norfolk naturalists are aware of this danger and are taking steps to try to avert it.

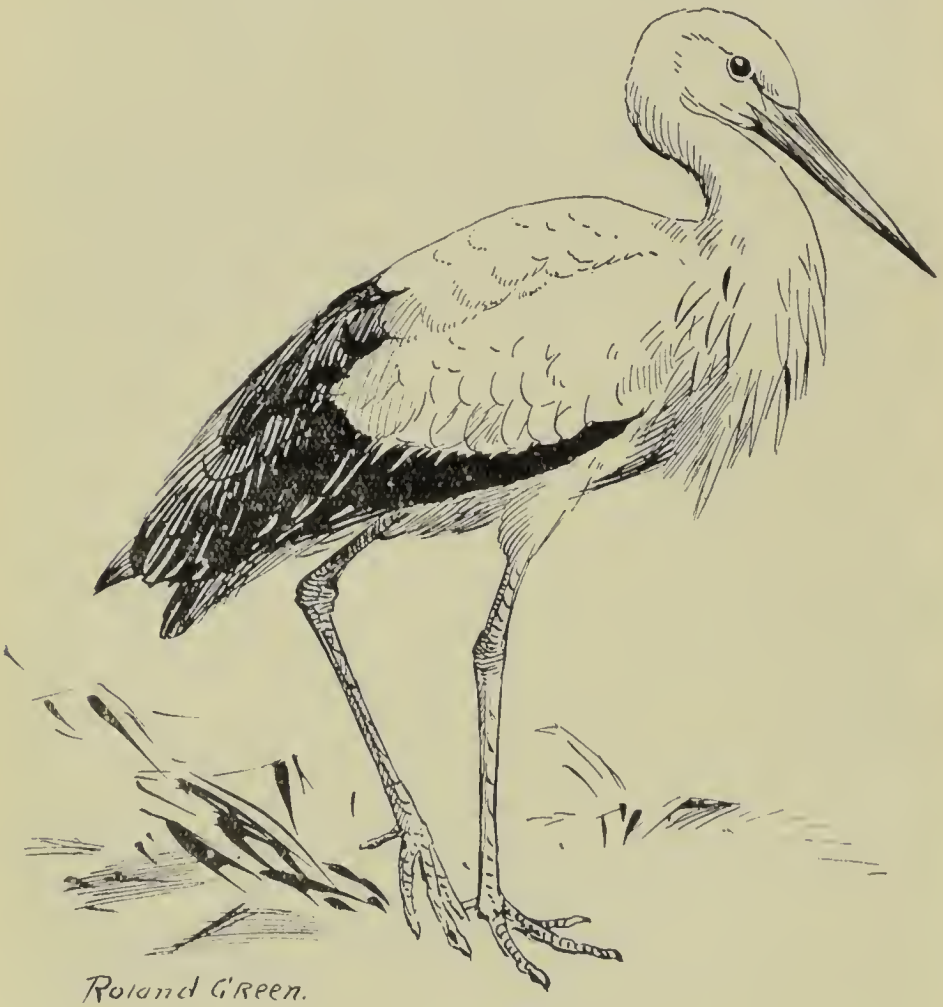
Breydon

It is with much regret that the Committee has been obliged to accept, on the score of health and age, the resignation of George Jary, who was held the post of watcher on Breydon for the past twenty-five years. During the past summer, except for about three weeks when he was laid up, Jary was able to continue at his post, living in the Committee's houseboat on Breydon Water; but he now feels that he is not strong enough to face the exposure. The Committee wishes to record here its appreciation of his loyal service. A successor will in due course be appointed.

As will be known to most of our subscribers, Breydon Water is an extensive estuary, on which at one time indiscriminate shooting used to take place at all seasons of the year. It is not a nesting ground, but it is the port of call of many migrants, especially waders, during the migration seasons. It was here that Booth obtained a large number of the birds now in the Dyke Road Museum. For several years it has been visited by Spoonbills during the summer months—birds that fly over from one of the nesting colonies in Holland. Now, the Spoonbill is one of the birds that we hope to regain in Norfolk as a breeding species, and one of the objects of having a watcher on Breydon is to ensure that these visitors are not molested.

The earliest reference to the Spoonbill breeding in Norfolk is contained in a document bearing date 1300, where reference is made to the harrying of the eyries of the " Popeler " or Shovelard at Cantley and other places in Norfolk. Sir Thomas Browne (1605 to 1682) makes reference to " the platea or shouelard, wch build upon the topps of high trees. they haue formerly built in the Hernerie at claxton and Reedham now at Trimley in Suffolk. they come in march & are shot by fowlers not for their meat butt the handsomenesse of the same, remarkable

in their white colour copped crowne and spoone or spatule like bill." There are still from 80-100 herons' nests at the Reedham heronry, which is within sight of Breydon. What a rare sight would be this ancient heronry once again tenanted by the handsome Popelar with its " white colour copped crown and spatule like bill."



On the afternoon of June 14th a White Stork came to Breydon and remained till dusk, but this rare visitor departed during the night, and was not seen again.

Cley and Salthouse

In our last Report reference was made to the recent purchase of the 407 acres of the Cley marshes as a bird breeding Reserve. The property has since been handed over to the Norfolk

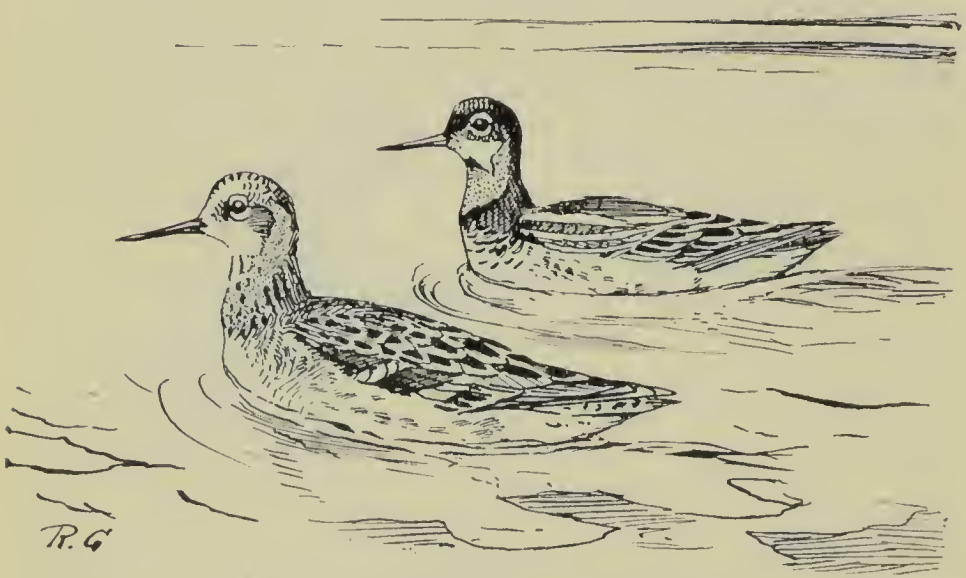
Naturalists Trust, which body will hold it as such for all time. Robert Bishop, of Cley, has been appointed Watcher, and he was on duty throughout the year.

To give the fullest encouragement to birds intending to nest, the marshes were left undisturbed between February 15th and September 15th. However, from the point of vantage of the East Bank an uninterrupted view of the whole area is obtained, so that one has a fairly good idea of its bird population during most of the year. On the other hand, as no census of nests was made, it is possible that some species may have escaped observation. At all seasons of the year there is usually something of interest to be seen by the bird watcher stationed on the East Bank, and during the past twelve months advantage of this has been taken by a large number of ornithologists. It is a pleasure to be able to record the fact that on no occasion has any visitor attempted to disregard the instructions of the watcher.

A certain number of ducks, principally mallard, teal and shovelers, are known to nest on the marsh, as also do a large number of Redshanks and Green Plover. A large and increasing number of Sheld-ducks nest on the inland heaths, and they bring their young to the marsh as soon as hatched. Indeed, the numerous Sheld-ducks to be seen on the marsh in the spring is one of its chief ornithological features ; on April 3rd the writer counted 55, and there were several others hidden from view by reeds, etc. On May 26th he found the first Sheld-duck ducklings, then about five days old.

Perhaps the most interesting birds seen on the marshes during the year were a Bittern, on February 15th and 18th ; a Spoonbill, which arrived on April 6th and stayed, with an interval of about a week, until the beginning of August ; for a few days in the second week in July it was joined by a second bird. On June 5th a female Red-necked Phalarope, in perfect nuptial plumage, arrived on the Salthouse side of the East Bank ; on the night of the 6th it was joined by a male, and both birds moved on the following night. They were seen by several ornithologists. Black Terns were seen passing through in May, and again in August and September ; and in the latter month an unusual number of Greenshanks were to be seen and heard about the marshes.

No terns nested on the Cley marshes this year, but there was a good colony on the Salthouse marshes on an island about 300 yards from the East Bank. On June 6th Miss Barclay-Smith and the writer counted 200 nests of the Sandwich Tern on this island ; one of these had three eggs, sixty had two eggs, and the remainder one egg. On the same island there were seventeen nests of the Common Tern and twenty-five of the Black-headed Gull. On the adjoining marsh belonging to the Norfolk County Council Mr. Yeo counted 201 nests of the Common Tern on June 3rd.



RED-NECKED PHALAROPES (*see page 339*)

The first Sandwich Tern's egg on Salthouse Broad was found by the keeper, Holman, on May 15th, and on June 15th the first chick was hatched. During the cold, rainy weather of the latter half of June many of the young succumbed, and on the 30th Holman found forty dead Sandwich chicks, and many of the Common Terns' nests had been washed out. After this the weather improved and, considering the season, the Salthouse birds did well.

During the year a much-needed shelter, a shepherd's hut, has been supplied for the Cley watcher.

BLAKENEY POINT

On an exposed area like Blakeney Point a calm, still day is rarely experienced : there is nearly always a wind, and a wind

of considerable force. Such winds always seem to depress and demoralise most passerine birds and it is generally hopeless to go bird watching ashore under such climatic conditions. Not so with sea-going birds, such as terns and gulls ; they would seem to revel in a good breeze, and were it otherwise they would certainly not select such a wind-swept area as the Far Point on Blakeney Point for purposes of nesting. It is a little difficult to realise this sometimes, as it was for the writer when staying on the Point between the 11th and the 19th of June of this year, during which week there were not five minutes of calm, and on most days so cold a wind that winter clothing had to be worn. The terns were all sitting, but the prospects of any eggs hatching out seemed small, especially after one night's deluge of rain with very high wind. On the top of a ridge of shingle between the two main terneries an Oyster-catcher was incubating her four eggs in a mere depression in the stones, and exposed to all the fury of the gales and rain. So suspicious was she of human beings that she would leave her nest when anyone approached within a quarter of a mile of her, and during that week she must have been put off dozens of times by visitors to the ternery. In due course all the eggs hatched out !

As regards the terns, the point of special interest this year at Blakeney was the large breeding colony of Sandwich Terns ; there must have been upwards of 500 nests of these birds on the Far Point. On one small area, four yards by three, there were forty-two nests, and the eggs presented great varieties in coloration. Of Common Terns there were about the usual number, but in the Long Low colony the nests were more distributed in the dunes than is usual.

Two nests of the Roseate Tern were identified ; the one on the Far Point, very near to where there was a nest last year ; the other, discovered by Mr. Stuart Baker and Mr. Coltart, " on the beach just inside the hillocks on the outer side of what Pinchen calls the ' big low.' There were two eggs quite typical of the species, small and speckly, and we watched the tern twice down on to the nest." For the greater part of each day the mate of the sitting bird on the Far Point was to be found resting on the sand within a few feet of the nest. Both of these nests hatched off successfully.

When looking at a large number of terns in the air, such as can be seen on Blakeney Point, one often sees a distinct pink colour on the breast of birds which are not Roseates, and that this is not always imaginary on the part of the observing eye was proved to the writer this year. A Sandwich Tern showing no trace of injury was picked up dead on the sands, and when the feathers of the breast of this bird were slightly separated and looked at from a certain angle the all-white colour was replaced by a very distinct pink.

A few pairs of Arctic Terns were identified, as usual, in the colony, and the writer watched one bird on to its nest. Forty-two Little Terns' nests were found by Pinchen on the shingle ridge between the two main nesting grounds.

On June 16th a tour was made of the ternery on the Far Point. During the night the wind had shifted from the north east to the south, with a consequent rise of several degrees in temperature, though it was still blowing strong. The first Sandwich Tern chick of the year was found, and there were a few of the Common Tern, which had been hatched the previous day. After this date hatching proceeded apace. As an indication of the kind of weather prevailing at the time, it may be mentioned that on June 19th, owing to a strong S.W. gale, it was impossible to cross to Morston by boat, so that two friends of the writer who had to return to London that day were obliged to walk to Cley, somewhat heavily laden with cameras and other impedimenta.

As has often been observed, terns, and especially the Arctic, will boldly resent intrusion upon their nesting ground, and as an example of such pugnacity it may be recorded that on one occasion during his visit to the Point this summer the writer was attacked from behind by a stooping bird which struck his uncovered head, though it failed to draw blood.

Despite the execrable weather during the whole of the incubation period the Sandwich terns on Blakeney Point had a good hatching; and towards the end of July and in early August it was most interesting to watch the regiments of young birds parading the nesting ground. They strutted about in companies of from 50 to 200 strong, and were a source of much amusement to visitors. The Common Terns did not fare quite so well; indeed, owing to blowing sand, many

Photo *F. W. Oliver*

A Company of young Sandwich Terns on Blakeney Point, August, 1927

Photo *F. W. Oliver*

Sandwich Terns on and above their nests on Blakeney Point, 1927

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of the first eggs became clogged during the hatching of the chicks, among which there was a high mortality. But in a large number of cases second clutches were laid, which hatched out and the young reached the stage of flight.

There were seven Oyster-catchers' nests on the Point this year; three on the Yankee ridge, two on the Hood, one on the Beachway and one on the shingle ridge leading to the Far Point. All these nests hatched off.

Six nests of Redshanks were found, one of these being placed, as last year, in the grass on one of the diminutive dunes on the Far Point, in the middle of the ternery.

Prosecution for Taking Terns' Eggs on Blakeney Point

At the Holt Petty Sessions on July 8th, 1927, John Cuthbert Worley, of 15, Sandown Road, Leicester, described as a dealer in eggs, was summoned for taking six Common Terns' eggs on Blakeney Point on June 6th. His mother and an employee, William Freer Sharp, of the same address, were summoned for aiding and abetting. Mr. H. O. Brown, Deputy Clerk to the Norfolk County Council, prosecuted, and defendants did not appear.

Evidence was given by Captain Lloyd that on Bank Holiday June 6th, when assisting Pinchen in his work as watcher on the Point, he saw the three defendants walking in line over the Old Ternery and obviously looking for nests. He saw John Worley pick up something which he put into his cap, and stoop again to pick up something further on, which he transferred to his pocket. On going up to him Capt. Lloyd found that he had in his possession two clutches, each of three eggs, of the Common Tern. One clutch was replaced in the nest from which it was taken; the other was produced in Court. Capt. Lloyd explained to the Bench that there were notices on the Point stating that eggs must not be taken, nor the birds disturbed during their nesting. The Chairman of the Bench (Mr. W. Towler) said the magistrates were determined to stop this interference with the protection given at Blakeney, and that the defendant Worley would be fined the maximum penalty of £1 for each egg taken, or £6 in all; and the other two defendants £1 each for aiding and abetting. The eggs were confiscated by the Court.

Scolt Head Island

The importance of Scolt Head Island as a breeding area and as an observation station for migration is becoming more obvious as evidence accumulates. With its extensive dunes, shingle beaches, and salt marshes and large feeding-grounds for waders the possibilities for attracting birds are great. The experimental planting of shrubs on certain selected spots on the island for the attraction of passerine birds is being proceeded with, and during the year considerable progress in this direction has been made.

This island and Blakeney Point would seem to offer alternative nesting sites for the large colony of Sandwich Terns that have come to Norfolk during the past few years, and during 1927 most of these birds nested at Blakeney.

The first terns were seen, off the Lynn Well Lightship, on April 9th, and a week later nine Sandwich Terns were seen off the island. On the 19th the first Common Terns arrived.

On July 3rd, the first warm sunny day after a fortnight of wet weather, we made an inspection of the island. There were twenty-one Sandwich Terns' nests containing twenty-five eggs. Common Terns' nests were numerous, and the watcher, Charles Chestney, reported that he had counted 584. Many of these eggs became choked with blown sand during hatching, but in a number of instances second clutches were laid, and on August 1st we counted 100 nests containing, mostly, two eggs. Although a large number of the first hatched chicks died from cold and blown sand, these second hatchings were mostly reared.

There was an unusually large number of Little Terns nesting on the island this year, and the watcher counted over 100 nests. Twenty-nine nests of Redshanks were found, and over 100 nests of the Ringed Plover.

There were fourteen Oyster-catchers' nests, all of which hatched off. In two instances a high tide washed the eggs out of the nests, where they remained for some hours before being discovered and replaced by the watcher; and as late as August 1st one clutch of three eggs was still being incubated.

It is impossible to estimate with accuracy the number of Sheld-ducks that nest on the island, but on March 4th the watcher counted fifty that were apparently inspecting rabbit holes.

Short-eared Owls did not nest on the island this year, but their nest of last season with an unhatched egg in it was discovered by Chestney. At frequent intervals between January and May one or more Short-eared owls were seen.

In previous Reports reference has been made to the large number of Swifts that pass from east to west along the north coastline of Norfolk during both the spring and autumn migration, and when staying on Blakeney Point between June 11th and the 19th such a movement on a considerable scale was observed by the writer on almost every day. Whether these birds were on their way to, or were returning from, the north, it was impossible to say. When one watches these birds migrating against a strong head wind one feels that occasionally they must need to rest, or, at any rate, the least vigorous of them ; but if so, where do they rest ? In this connection it is interesting to record the fact that on a day about the middle of August Chestney found a Swift clinging by its claws, in a vertical position, to the exposed roots of marram grass in the wall of a blow-out in the dunes. The bird allowed him to pick it off by his hand, and when he tossed it into the air it flew off and immediately started catching insects. Within a day or so of this he found two Swifts lying on the shore with outspread wings, the one dead, and the other at its last gasp. Neither of the birds appeared to be injured in any way, and one can only conclude that they had dropped from exhaustion. Such must be the fate of a large number of migrating birds.

Unusual migrants are occasionally seen, and amongst these may be mentioned five Crossbills seen at close quarters by the watcher on July 20th. The birds were hanging on ragwort stems. About the same date Dr. Sumpter saw three Crossbills in his garden at Brancaster Staithe. These birds were doubtless part of the large immigration that came to England during this summer.

During the latter part of August and the first ten days in September there was a very large number of Pied Flycatchers and Common Redstarts on the island. These two species were

also very numerous about Cley and on Blakeney Point ; so much so that 1927 will undoubtedly be remembered as a Pied Flycatcher year.

Wolferton

As foreshadowed in last year's Report, the Committee has reluctantly come to the conclusion that it is futile any longer to try to protect the rapidly diminishing colony of terns that still cling to this nesting ground, and in taking this step it has the approval of His Majesty the King, who has the sporting rights over the area.

A few terns arrived in May, but they nearly all moved on—probably either to Scolt Head Island or to Blakeney. We visited the ground on May 15th, when we found but two Common Terns and a few Little Terns, and the keeper had found only two nests. A gang of men were at work transferring shingle to a beached ship, and we were informed that this work was going on every day so that the birds were constantly being disturbed. It is to be regretted that this, one of the first breeding grounds to be protected in Norfolk, should, literally, be removed for road-making and building purposes.

Rare Breeding Birds

Although the Woodcock is known to nest in many parts of England it is not often that its eggs are found in Norfolk. It may therefore be recorded that a nest containing four eggs was shown by a keeper to Dr. A. H. Evans at Didlington on April 29th. The eggs were stone cold and the nest obviously deserted, and under these conditions the keeper allowed Dr. Evans to take the eggs, two of which he gave to the writer for the Norwich Castle collection, and the others he presented to the collection at Cambridge.

A pair of Magpies nested and hatched off in a wood in the Broads district, and another was seen several times during the first two weeks in May on a north Norfolk heath. A careful search for the nest of this bird was unsuccessful. Except on the western borders of the county a Magpie is rarely seen in Norfolk in these days.

In the ruined masonry of the old paper mill at Taverham a pair of grey Wagtails nested again this year.

For the past two years Hooded Crows have undoubtedly nested at Winterton, though a nest has never been found. On June 29th of this year, and before the eclipse had entirely passed off, we saw a pair of Hoodies with three young ones on the dunes bordering Winterton Warren. These young birds must have been hatched somewhere in the immediate neighbourhood.

Although the Tufted Duck, like the Gadwall, has been steadily increasing in numbers in West Norfolk for some years, it is very rarely that this species has been suspected of nesting in the Broads district. We know of but two instances; at Hickling, in 1912, a nest was found, which was afterwards deserted; and at Salhouse, in 1913, a brood was seen on the river Bure. It is therefore now worth recording that, although the nest was not found, there is no doubt but that a pair of Tufted Ducks bred on Alderfen Broad this year. On June 1st Mr. Callow saw a female with seven young, swimming on the Broad, and he considered that the ducklings were not more than twenty-four hours old. On the 9th the writer was taken on to the Broad by Mr. Goodchild, and saw the female Tufted Duck with two ducklings; the other five, as was eventually the fate of the remaining two, had been killed by either pike or otter.

From reliable sources of information and from our own observations we can assure our supporters that the Bittern is continuing to receive adequate protection. The problem is, what happens to all the young Bitterns that are annually hatched in Norfolk? If they remained to breed in the county then, by this time, all suitable nesting areas would be occupied, but such is not the case; indeed, the breeding range is very circumscribed, although there are plenty of reed-beds in other parts of the county which as yet remain untenanted.

After being nearly wiped out in the winter of 1916-17 the Bearded Tit is now almost one of the commonest birds in certain parts of Broadland. During the past season they seemed to be very prolific, and, in certain areas, might now be described as numerous. As will be known to readers of these annual reports, a certain number of Montagu Harriers usually nest in Norfolk, but during this past year only one nest was found

and it is unlikely that there were others, at any rate in the immediate neighbourhood of this nest.

The Marsh Harrier is one of the rarest nesting birds in Norfolk. and until this year an interval of six years has elapsed since the last nest was found. At the beginning of May three females and a male were frequently seen, the former being easily identified as they all varied slightly in plumage. In due course a nest was found, and the precaution was taken of having it watched night and day by two special watchers. After sitting for two weeks the bird left the nest early on the morning of May 30th and never returned to her three eggs; when examined, these were all found to be infertile. Suspicion had been aroused that she was an unmated bird, as the male had never been seen bringing food to her.

Mr. N. Tracy's Bird Notes

Mr. Tracy reports that for the first year since 1918 he failed to discover any Crossbills' nests in his district—near King's Lynn—this year. However, on July 20th he found a flock of eight feeding on cones in his wood, and a little later heard "several small parties flying over." It was at this time (July 20th) that Crossbills were seen on Scolt Head Island.

It is very satisfactory to hear from Mr. Tracy of the increase of the Wood-Warbler in that part of Norfolk, and also of the Nightingale. He says: "There were about eleven pairs of Nightingales and ten pairs of Wood-Warblers within a radius of about one-third of a mile of my wood," and in a wood at Snettisham he located six pairs of Wood-Warblers. From our experience this species is more generally distributed in Norfolk than is commonly supposed. Speaking generally, Mr. Tracy says there seemed to be an increase in the number of Willow-Wrens, Chiff-Chaffs, Wood-Warblers, and Nightingales; whereas Cuckoos, Tree Pipits, Yellow Wagtails, Black-caps and Turtle Doves seemed scarcer than usual.

The following is a list of the birds that nested in Mr. Tracy's wood this year, with the number of nests of each species. As compared with last year's list there is an increase of thirty-two nests, with the addition of the Pheasant and House Sparrow as new-comers.

	Nests.		Nests.
Blackbird	5	Wood Pigeon	6
Song Thrush	9	Stock Dove	1
Mistle Thrush	13	Turtle Dove	1
Wren	4	Starling	3
Robin	7	House Sparrow ...	1
Goldcrest	3	Nuthatch	1
Chaffinch	20	Tree Creeper	7
Great Tit	6	Spotted Flycatcher ...	5
Blue Tit	5	Pheasant...	4
Cole Tit	2	Willow Wren	7
Marsh Tit	1	Lesser Redpoll ...	4
Long-tailed Tit ...	1	Common Redstart ...	5
Pied Wagtail	2		—
		Total	123
			—

Bird Protection in Norfolk, as elsewhere, is a problem beset with many difficulties, which can only be surmounted by experience and the expenditure of money. The former is being gradually accumulated; the latter we hope will be forthcoming from those who are in sympathy with the Committee in its work. There is much yet to be done, and it is hoped that all into whose hands this Report may fall will support the Committee with a subscription.

Signed (on behalf of the Norfolk W.B.P. Committee),

SYDNEY H. LONG, *Hon. Sec.*

LIST OF SUBSCRIPTIONS AND DONATIONS TO THE NORFOLK WILD BIRDS PROTECTION FUND FOR 1927

	£	s.	d.
H.M. THE KING ...	3	3	0
H.R.H. THE PRINCE OF WALES, K.G. ...	2	2	0
Adam Miss H. ...	1	1	0
Adcock E. D. ...	1	1	0
Agnew C. G. ...	1	1	0
Allars R. W. E. ...	3	3	0
Allen J. L.		5	0
Allen J. W.	1	1	0
Andrews W. H. M.		10	0
Baker E. Stuart ...	3	3	0
Carried forward ...	16	10	0

	£	s.	d.
Brought forward ...	16	10	0
Barclay F. H. ...	1	0	0
Barclay H. G. ...	2	2	0
Barnard Mrs. ...	1	1	0
Barrow Miss		10	0
Barry T. H.	1	1	0
Barry W. J.	1	1	0
Barton S. J., M.D. ...	1	1	0
Bedford Her Grace the Duchess of ...	2	2	0
Beevor Sir Hugh, Bart.	2	2	0
Carried forward ...	£28	10	0

	£	s.	d.
Brought forward ...	28	10	0
Bell J. H.		10	0
Bidwell E.		10	0
Blakeney Point Collecting Box ...	1	16	0
Boardman E. T. ...	1	0	0
Boileau Sir M., Bart.	1	1	0
Brash T.	2	2	0
Brereton Miss E. D.	2	0	1
Brittain H.	1	0	0
Brooks J. R. ...	1	1	0
Brown E.	1	1	0
Brown H.	1	1	0
Buckle Lt.-Col. D. W.	1	1	0
Budd C.		5	0
Bullard Ernest ...	1	12	0
Burrowes R. B. ...	1	0	0
Burton S. H., F.R.C.S.	2	2	0
Butcher R. W. ...	2	0	0
Buxton E. G. ...	2	2	0
Buxton G. F. ...	3	3	0
Buxton W. L. ...	1	1	0
Byers J.		10	0
Byne Lt.-Col. R. M.	1	1	0
Candler Charles ...		10	6
Capron J. T. ...	1	1	0
Carr Mrs.		10	0
Carruthers D. ...	2	2	0
Chadwick Dr. Morley	2	2	0
Chamberlin Sir G. ...	1	0	0
Chapman E. H., His Honour Judge ...	3	3	0
Christie J. A., M.P. ...	1	0	0
Cleminson H. M. ...	1	0	0
Coates John ...		10	0
Coe Mrs. A. E. ...		10	0
Collins W. G. ...		5	0
Colman Miss E. ...	1	1	0
Colman Miss H. C. ...	1	1	0
Colman R. J. ...	1	1	0
Colomb Admiral P. H., C.B.	1	0	0
Cooke A., F.R.C.S. ...		10	0
Cozens-Hardy A. ...	1	1	0
Cresswell Mrs. George	1	1	0
Cruickshank W. G. ...		11	0
Davey G.		10	0
Deacon G. E. ...		10	0
Dew Mrs.		11	0
Dewar T. F., C.B., D.Sc., M.D. ...		10	0
De Worms C. ...	1	1	0
Doughty C. G. ...	1	1	0
Drury G. L.		10	6
Duncannon T. J. G. ...	3	3	0
E. B. S.	1	1	0
Edwards Francis ...		10	0
Carried forward ...	£87	16	1

	£	s.	d.
Brought forward ...	87	16	1
Ennion E. F. R., M.R.C.S., L.R.C.P.		10	6
Ferrier Miss Judith ...		10	0
ffolkes Sir W., Bart. ...	1	1	0
Friedlein W.		10	6
A Friend		10	0
Gadesden Miss ...		10	6
Gayner Dr. J. S. ...	1	1	0
Gay Miss C. E. ...	1	1	0
Giles C. C. T. ...		5	0
Glanville J. P. ...	1	1	0
Glegg William E. ...	1	0	0
Goddard W. N. ...		10	6
Gossage Col. W. W. and Mrs.	2	2	0
Gowen H. P. ...	1	1	0
Graves Mrs.	1	1	0
Gurdon E. T. ...	1	1	0
Gurney G. H. ...	2	2	0
Gurney Q. E. ...	1	1	0
Gurney R.	1	1	0
Gurney W. S. ...	1	1	0
Halls H. H. ...	1	0	0
Hannaford G. ...	2	2	0
Harding J. R. ...		5	0
Harker W.	1	1	0
Harmer B.	1	1	0
Harvey Miss C. ...		5	0
Haydon W.		5	0
Herbert E. G. ...	1	1	0
Heywood R.	1	1	0
Hill T. A. M. ...	1	1	0
Horsfall R. E. ...		10	0
Howard C. B ...		10	6
Howlett Dr. J. K. ...		11	0
Hudson Lt.-Col. P., C.M.G., D.S.O. ...	1	0	0
Jago C.		10	0
Jessop A. L. ...	2	2	0
Johnson Miss A. M. ...		2	6
Jones Sir Laurence, Bart.	1	1	0
Keith E. C.	1	0	0
Ketton-Cremer W. C.		10	0
Kinder Rev. E. H.	1	1	0
Knight E.	1	0	0
Lang Gordon L. ...	2	2	0
Lee-Elliott Rev. D. L.	1	1	0
Lewis J. Spedan ...	2	2	0
Lister S. R., M.D. ...		11	0
Littlewood Miss ...		10	0
Lloyd Capt. L. ...	1	0	0
Do., special donation	1	1	0
Long Miss		5	0
Long F., the late ...		5	0
Long S. H., M.D. ...	2	2	0
Carried forward	£136	16	1

	£	s.	d.
Brought forward ...	136	16	1
Lucas Dr. G. ...	1	0	0
Mack H. P.	1	1	0
Macpherson A. H. ...	1	1	0
McKenna Mrs. R. ...	1	1	0
McKenzie Miss G. ...		10	0
Meade-Waldo E. G. B.	1	1	0
Meadows Mrs. A. H....		10	0
Mennell E.		10	0
Micholls Mrs.	1	1	0
Millard Miss I. M. ...		5	0
Miller O. T.		5	0
Milne Mrs. Findlay ...		10	6
Mitchell Arthur ...	1	1	0
Moxey J. E. ...	1	0	0
Murton Mrs.	1	0	0
Nash J. E.		10	0
Nash W.	1	0	0
National Trust, The...	10	0	0
Newman Miss F. B. ...		10	0
Oliver Prof. F. W., F.R.S.	1	1	0
Oswald Nigel ...	8	18	6
Pain P.	1	1	0
Patteson Mrs. F. E.		10	0
Pearson S. V., M.D.		10	0
Penrose F., M.D. ...	1	1	0
Plowright Dr. C. T....	2	2	0
Poole Miss D. Lane ...		5	6
Powell A. M. ...		2	6
Preston Sir E., Bart., D.S.O.	1	1	0
Purdy T. W.... ...	1	1	0
Raikes Miss D. T. ...		5	0
Ransome Mrs. ...	1	1	0
Reeves H.	1	1	0
Richmond H. W., F.R.S.	5	2	0
Riley W.	1	1	0
Ringrose B.	1	1	0
Riviere B. B., F.R.C.S.	2	2	0
Robertson W. K. ...		10	6
Rogers Rev. H. ...	1	0	0
Rose L.	1	0	0
Routledge V. ...		10	0
Royal Society for the Protection of Birds	2	2	0
Ruggles-Brise Mrs. R.	1	0	0
Carried forward	£196	1	7

	£	s.	d.
Brought forward ...	196	1	7
Sargent C. G. ...	1	1	0
Savill Harry	2	2	0
Savin A. C.		5	0
Savory Mrs.		10	0
Scolt Head Collecting Box	2	5	2
Scroope H. W. ...		10	0
Sewell P. E.	2	2	0
Sheldon W. G. ...		10	6
Simpson F. T. ...	2	2	0
Smith Col. H. F. ...	1	1	0
Smith W.	1	1	0
Soman A. E. & Co. ...	1	1	0
Spalding G.		10	0
Steward Rev. Canon...	1	1	0
Stewart G. B. ...	2	2	0
Stimpson E.		10	0
Strachan C. E. ...	1	1	0
Sumpter Dr. B. G. ...	2	2	0
Tait W. C.	1	0	0
Tancock Canon O. W.		5	0
Taylor Dr. Mark ...	1	0	0
Thompson W. H. ...	1	0	0
Thomson C. R. White		10	0
Thorpe W. H. ...	1	1	0
Thouless H. J. ...		10	0
Tuke Anthony W. ...	1	1	0
Upcher H. E. S. ...	1	0	0
Upcher Miss L. ...	2	2	0
Vesey W. Trevor ...	1	0	0
Vincent T.		2	6
Walter C. H. ...	1	1	0
Walter J. H. F., the late	1	1	0
Watson-Kennedy Mrs.	1	1	0
Wells C. H.	1	1	0
Willett W. L.... ...		5	0
Wilson Mrs.	1	1	0
Winch Major S. B ...	2	2	0
Wormald Hugh ...	1	1	0
Wright Dr. B. D. Z. ...		10	0
Wright T. J. ...		10	6
Wyllys H. J. M., F.R.C.S.		10	0
Wyllys W. E. ...		10	0
Yeo Henry		10	6
Yeo Mrs.		10	6
Total ...	£240	4	3

NORFOLK WILD BIRDS PROTECTION FUND

Year ending December 31st, 1926

Receipts	£	s.	d.
Balance, December, 1925 ...	59	7	7
Subscriptions	229	7	6
Blakeney Point Collecting Box ...	4	3	6
Scolt Head Collecting Box ...	3	18	0
	£296	16	7

Expenditure	£	s.	d.
Watchers—Brcydon	37	3	0
Scolt Head	108	4	11
Blakeney Point ...	30	0	0
Wolferton	10	0	0
Scolt Head—Sundry Expenses ...	3	2	3
Printing Report	14	5	0
Tern Enquiry Expenses	6	6	0
Hon. Sec.—Postage Expenses ...	3	11	6
Cheque Book	0	2	0
Balance	84	1	11
	£296	16	7

NORFOLK WILD BIRDS PROTECTION FUND

Year ending December 31st, 1927

Receipts	£	s.	d.
Balance 1926 (brought forward)...	84	1	11
Blakeney Point Collecting Box ...	1	16	0
Scolt Head Collecting Box ...	2	5	2
Subscriptions and Donations ...	236	3	1
	£324	6	2

Expenditure	£	s.	d.
Wages of Watchers, etc. ...	176	2	1
Balance, 21st October, 1927 ...	148	4	1
	£324	6	2

Examined and found correct

W. A. NICHOLSON

Honorary Auditor

November 1st, 1927

X

SOME BIRD NOTES FROM TAVERHAM AND RINGLAND

By Capt. L. Lloyd

Grey Wagtail

The first nesting of the Grey Wagtail at Taverham in 1923 is recorded in the Society's Transactions, Vol. XI., p. 432. Since then a pair of these birds have nested regularly year by year in the masonry of the Mill, and have sometimes remained through the winter. In 1926 and 1927 a Cuckoo laid in the nest, on the latter occasion when the nest was empty, the young birds having been killed by vermin. Grey Wagtails have also been seen in October during the last four or five years on the trout hatchery at Weston, at Lenwade, Whitwell, Costessey, and on the pond at Drayton.

GADWALL

A Duck Gadwall was shot on January 7th, 1924. It would appear that this is the first time, at any rate for several years, that Gadwall have been observed on this part of the River Wensum. They were evidently brought in by the severe weather which lasted from January 1st—14th, together with quantities of Mallard, Teal, a few Tufted Duck, Pochard, and Goldeneye.

There is no direct evidence in the shape of a nest that these duck have bred here, but the occurrence of a pair on May 6th, 1925, and two lots of two drakes on April 18th and 23rd, 1926, show that it is quite possible that they may have done so. Gadwall have not, I believe, been observed above Lenwade and below Elsing Mills. They have increased considerably since first observed.

WOOD LARK

Wood Larks' nests have been found north of Norwich during the past three or four breeding seasons. A pair with young were seen in the parish of Taverham in May, 1926. A cock was heard singing in the same vicinity on February 16th. A nest was found in March and another in May, 1927.

REDSTART

The first Redstart's nest in this neighbourhood for many years, probably between thirty and forty, was found on May 17th, 1927; this was unfortunately disturbed by boys, but the old birds built a second nest in the same hole and hatched off five young which flew on or about June 30th.

The parent birds had been observed in previous springs. One in 1924, a cock bird in May, 1925, another cock in 1926.

OBSERVATIONS OF INTEREST, OCTOBER, 1926—OCTOBER, 1927

Norfolk Plover heard for last time for the year on October 13th, 1926.

A late House Martin was seen on October 20th.

A Golden Plover was heard on November 22nd, the first for several years just here.

The first Brambling appeared on November 6th; a big influx of these birds took place this Autumn. As many as two

hundred in a flock were seen feeding in company with a few Chaffinches under the beech trees. They remained till the first week in March.

A flock of a dozen Crossbills was seen on January 1st. They remained round the house till the 10th.

A large flock of Lesser Redpolls was feeding on the alders on February 12th.

A Ringed Plover put in an appearance in May and was seen on a gravelly beach on the river on the 2nd, 4th, 5th, and 13th.

A neighbour caught a Hawfinch in a net over their raspberry canes on July 4th, the first seen here for several years.

Little Grebe returned suddenly in numbers on the river on October 3rd. While flighting on October 5th I heard a snipe "drumming"; is this not rather late?

During the summer two Cuckoo's eggs were found in empty nests, the first with Grey Wagtails already referred to, the second in a Wren's inside my workshop. Some people still insist that the Cuckoo never places its eggs in other birds' nests with its bill.

The nests of forty-five different kinds of birds were found here this breeding season.

One hundred and nineteen different species of birds have been recorded within a one and a half miles radius of Taverham since the War.

XI

CLEY-NEXT-THE-SEA AND ITS MARSHES

By Basil Cozens-Hardy

As the Norfolk Naturalists Trust is now a considerable land-owner in the parish of Cley-next-the-Sea, Norfolk, it has been suggested that some observations on the history of the locality may be of interest to Norfolk naturalists. In the remarks that follow I shall avoid ecclesiastical matters, and confine myself chiefly to the topographical and commercial history of the town and the immediate neighbourhood.

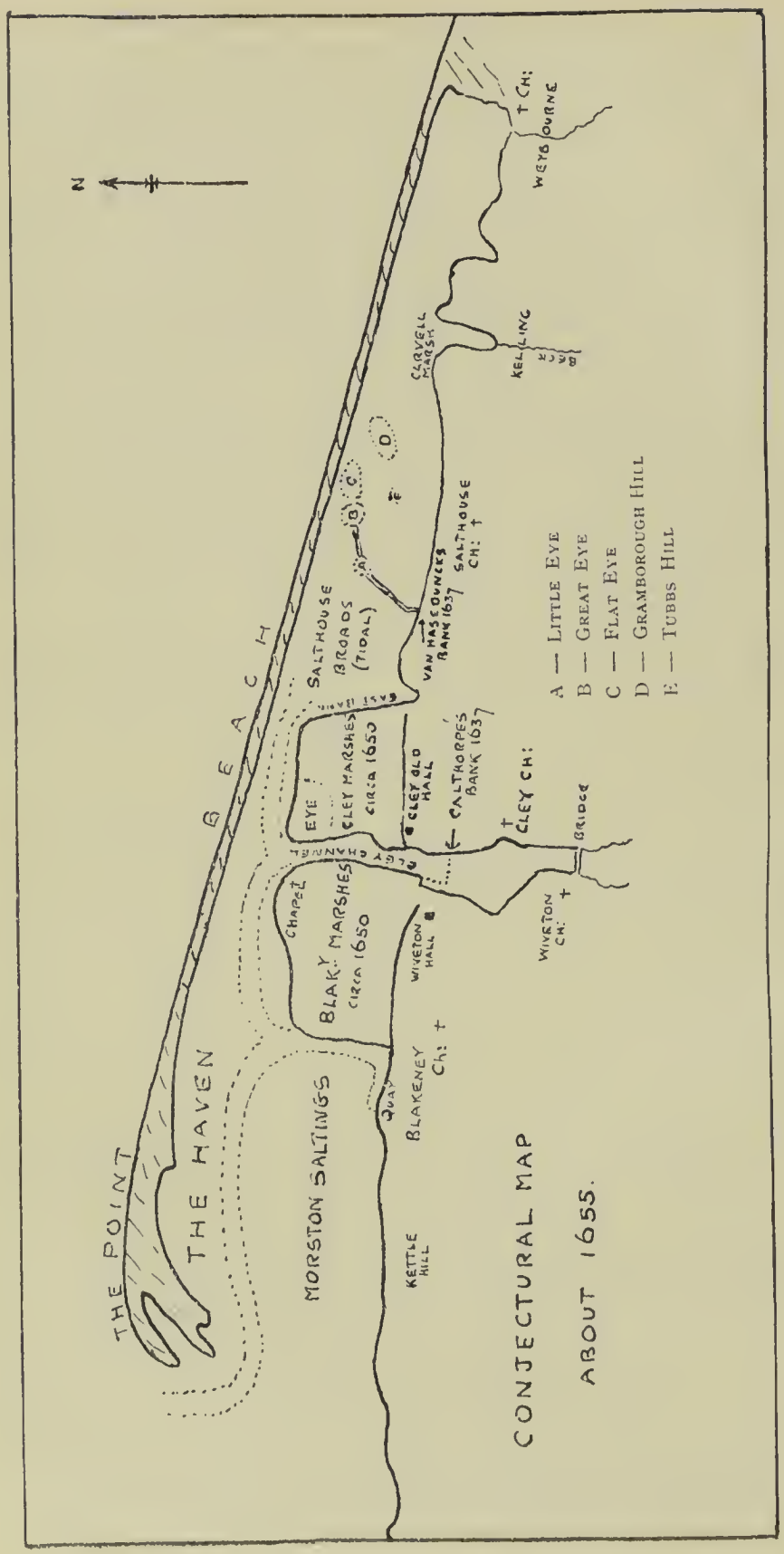
The origin of the place-name is in doubt. Those qualified to suggest are of the view that the name represents O.E. clæg " clay " and was so called from the clayey character of the soil, either in the marshlands or in the chalky marl of the upland sub-soil.

Cley owes its existence to the River Glaven, a short and, for Norfolk, a fast running stream of 12 miles length, rising east of Holt, at Bodham, and passing through five water mills in its course. If its waters had not had to find an outlet, there would have been no Cley or Blakeney harbour or anything in the nature of a haven or anchorage lying south of Blakeney Point.

That this neighbourhood has been populated since the earliest times is evidenced by the large group of barrows existing on the uplands of Cley and Salthouse and on Kelling Heath. Exploration of these barrows, has indicated a resident population about 2000 B.C.

Cley marshes as they are to-day were non-existent till the middle of the XVIIth Century. They were merely tidal muds like the saltings north of Morston, growing the typical seamarsh vegetation on the less frequently inundated parts and intersected by numerous meandering creeks.

It is interesting to speculate about the appearance in the Middle Ages of the reach of marshes from Blakeney to Kelling ; much depends upon the extent of the Point. I have no knowledge of tides, currents, or sandbanks, but I have always the impression that the cliffs of vanished Shipden, off Cromer, are deposited on the shore extending from Kelling westwards to Brancaster and that, as far as Cley was concerned, there has always been a battle proceeding between the river Glaven endeavouring to force itself by the most direct route to the sea, and the currents driving backwards and westwards the beach and sandhills. The same battle, but in a minor degree, existed at Weybourne in the case of the small stream which drove the Prior's waterwheel there, and of Kelling Beck. It is worth while noting that the Weybourne stream, which used up to a few years ago to find an outlet round the uplands into the Kelling and Salthouse marshes and thence into Cley channel, has had its ancient right of way recently obstructed by the encroaching shingle and it has now to reach the sea by percolation through Weybourne beach at low tide.


N
THE POINT
THE HAVEN
MORSTON SALTINGS
BEACH
KETTLE HILL
BLAKENEY Ch: †
QUAY
BLAKY MARSHES CIRCA 1650
CHAPEL
WIVETON HALL
WIVETON Ch: †
EYE
CLEY MARSHES CIRCA 1650
CLEY OLD HALL
CALTHORPES BANK 1637
CLEY Ch:
BRIDGE
SALTHOUSE BROADS (TIDAL)
VAN HASE DUNCES BANK 1637
SALTHOUSE Ch: †
CLAYELL MARSH
KELLING
WEYBOURNE Ch:
A — LITTLE EYE
B — GREAT EYE
C — FLAT EYE
D — GRAMBOROUGH HILL
E — TUBBS HILL
CONJECTURAL MAP
ABOUT 1655.

To return to the question of the mediæval aspect of Cley sea frontage, there is some, but not strong, evidence that the Glaven flowed out at Cley near where it now takes the right-angled turn to the west. This would have insulated Blakeney Point. It is so shown in the Morden's map of 1698 (see photograph), but maps in those days were very unreliable in detail and two older maps discountenance this view. Moreover, if the river had not run out through the haven round the Point, the scour of the outflowing tide would have been greatly reduced, and the haven would have tended to silt up. I think, therefore, that it is improbable that the Blakeney Point was ever an island like Scolt Head.

Up to 1823 the sea flowed at every tide as far as Glandford. This accounts for three things: the tall arched stone bridge at Wiveton, the stone walls at the bottom of the upland from Town Yard in Cley, past the Green (near the Church), and as far as the Wiveton Bridge Road, and the somewhat straggling nature of both Wiveton and Cley. The houses were built along each side of the old estuary to get channel frontage.

Seawards the view would be very different from what it is at present. At a high spring tide probably the whole area now occupied by the Blakeney, Cley, and Salthouse marshes would be inundated. But besides the sea- and wind-made Point there would be standing out some pronounced islands, the product of glacial deposit rather than of gradual sea action. First there would be Thornham's Eye, now the N.E. corner of Blakeney Golf Links near the curving relief channel cut in 1924. On this Eye there was a Chapel, the foundations of which still exist. It was no doubt built and staffed by the Blakeney Carmelite Friars. It is said that there was always a Friar in attendance to bless passing boats, and that outside the chapel was an iron box fastened in the wall into which the fishermen dropped their thank offerings for a successful voyage.

By the kindness of Mr. Frank Monement, of Cley, I am able to reproduce a photograph of a map of the Haven in his possession, dated 1586. It shows, amongst other things, the Chapel and Friary, people gathering cockles, two men apparently fighting across a ditch, and two bridges at Wiveton,

A little further east, on the other side of the Cley Channel, we come to what was a large island, still known as "the Eye,"

and forming part of the property of the Norfolk Naturalists Trust. It was once a lay fee belonging to the Priory of Castleacre. The large Ordnance Map shows the site of a Chapel on it, but I think this is a mistake and such foundations as there are belong to a barn for agricultural purposes, as the Eye has no doubt been arable or pasture land since time immemorial. A description of the Eye in a deed of 1651 is as follows :—

> "All that piece of high marsh ground in Cley aforesaid called or known by the name or names of ffoulnesse or East Eye conteyning by estimacon three score and ten acres with one lodge or house thereupon built lying betwixt ye . . . . . marsh . . . . . hereinafter mentioned . . . . . on ye part of ye South and ye creeke comonly called Salthouse Channell on ye part of ye North and abutting upon ye creek called Cley Channell towards the West."

This Eye was probably approached by water down the Channel or by the Driftway which still runs through the centre of Cley marshes to the east corner of the Eye. It would be difficult to make a road close to this channel, which would be the most direct route, owing to the number of wide creeks which ran into it. This driftway is described in the deed just mentioned thus :—

> " Several posts and stulps set in a right line from a certain place five roods or perches eastwards from ye north end of a common way leading out of ye said North field of Cley called Procession Way Northwards to the most Easterly corner of ye . . . . . marsh called ffoulnesse or East Eye."

Stulps were guide posts beside a causeway. The marsh adjoining these is still called " Great Stulps."

The next island was, I suspect, situated somewhere near the north end of the present East Bank. At least, a map of 1649 of the Salthouse Marsh enclosure (see photograph) indicates some higher land at this point, called Rough Brough Hill, now long since beneath the sea. Further east, in front of Salthouse, there were four prominent islands : the Little Eye, the Flat Eye, the Great Eye, on which now is built that strange looking building called " Randall's Folly," (the Rocket House) and Gramborough Hill. Roman pottery has been found on the last, as well as at several points along the coast road.

If therefore one stood, say, in 1400, on a point on the uplands,

SALTHOUSE CHANNEL

CLEY

WIVETON

STIFFKEY MORSTON BLAKENEY

MAP OF BLAKENEY & CLEY HAVEN, DATED 1586

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one would have seen the whole expanse of land from Blakeney Point to Weybourne a huge salt marsh flooded at high tide. Here and there would be Eyes jutting out, some of them under cultivation. A broad navigable channel would run past Cley Quay and Cley Church up to and under Wiveton Bridge and possibly as far as Glandford. Another would run eastwards north of Cley Eye and of the area now forming the Cley marshes up to Salthouse and beyond to Kelling. At the present time, when in dry weather Salthouse marshes are only half flooded, the course of this navigable channel is still quite visible to anyone standing on Salthouse Heath above the church, and its course accords exactly with that shown on the map of 1649, here reproduced by the courtesy of Mr. Frank Monement.

The first part of the XVIIth Century was the great period of embankment. Between 1621 and 1656 the vast area of the Fens was reclaimed, in spite of much discouragement and opposition, by the directing skill of Sir Corneluis Vermuyden, the Dutch Engineer. When exactly reclamation began in the Cley district is not certain, but it seems in about 1637 operations of this kind commenced at Salthouse under the supervision of another Dutchman, named Van Hasedunck.

In 1638 there were some legal proceedings and an inquiry about "a new embankment lately made by John Van Hasedunck." Lady Sydney was the owner of "Greneburgh Hill" and of the Great and Little Eyes and the Flat Eye mentioned above. The allegation was, "the said new embankment made over the mayne channel between the great and little eyes" so "stopped and penned up the fresh water flowing from Waborne Mill and Kelling becke that the said Ladie cannot feed her grounds lying on the North side of the mayne channel which always have been known to be the right of the town of Salthouse." The inhabitants are excluded from "their fishing in the said channel and cricks" and from the sea "their chief means of livelihood" and "are forced to beg and seek new habitations." So ran the still extant depositions. The outcome of the law suit is unknown, though I imagine it was successful from what occurred twelve years later. Water rights and obligations have ever been a fertile source of dispute. The offending bank is shown on the map of 1649 and is there described as the "Old Bank," which seems to imply

that it was superseded in 1649, when the new and more extensive reclamation scheme was carried out as delineated on this map. It shows also the whole of the Salthouse marshes as far as the eastern boundary of the Trust's property, namely, the East Bank, which, however, had not then been completed, otherwise it would have been shown on the left edge of the map. The present beach line runs from the word " Salthouse " in " Salthouse Mayne Channel " to the north end of " Green Barrough Hill." This means that in about 275 years the sea has encroached by as many yards. Randalls Folly, already referred to, is on the Great Eye, and the present beach road runs through Tubbs Hill. When the 1649 embankments were made, as indicated on the west side of the map, the Salthouse main channel, then as wide as the Thames at London Bridge, became and remained for two hundred years an area flooded at each tide and acquired the name, which the locality still retains, of " Salthouse Broads." Just above and below the word " West " in " West Marish," are two interesting place names, " Dogger Layer Point " where they laid up their boats called " Doggers " (cf. The Dogger Bank), and " Little Harnser Marish," frequented then, as now, by herons.

About the same time Sir Henry Calthorpe of Cockthorpe, and, on his death his son Philip Calthorpe, began embanking their saltings at Blakeney and Wiveton, very possibly under the supervision of Van Hasedunck. Whether they first embanked the whole of the Blakeney marshes is (at present) uncertain. At any rate, they threw a bank across the river Glaven somewhere near the present one abutting the Cley-Blakeney road (see photograph). This did not prevent access of ships to the main Cley quays, but it obstructed water-passage up the Glaven valley to the south part of Cley near the Church and to Wiveton village. There was immediately consternation amongst the merchants and natives of these two townships, who saw ruin to their trade staring them in the face. The demolition of this offending sea-wall had to be secured at all costs. Their first move against what to us, knowing only one side of the question, seems a somewhat high-handed obstruction of a public and very valuable right-of-way was to induce the Vice-Admiral for this part of the coast to summon an " Admirall Court," which he did at Cley on the

Map, dated 1649, of Salthouse Marshes, showing Van Hasedunckes Bank (1637) in the left centre and later Embankments (1649) on the left

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31st January, 1638. Here is an extract (anglicised) from the record :—

"Thomas Coe foreman of Jury."

"Present that the channel existing from time immemorial with a free passage by water from Cley to Wiveton where coal ships and boats have had passage is now debarred and stopped up by a bank now lately made by Sir Henry Calthorpe —now Mr. Phillip Calthorpe."

The next move was to invoke the assistance of a local court of limited jurisdiction. There was a Department of the Manor of Cley-juxta-mare, which corresponded with what would now be called a Port and Haven Commission. They met as occasion required, and their proceedings are recorded in the Court Books of the Manor. Here is an extract translated from Latin into English :—

"Cley Port. Port of Cleye Blakeney and Wyveton.
A General Court there held the 11th day of December 1638 (13 Car.I)

Jury Thomas Clowdislie* Gentleman
(and 20 others)

Who say upon their oath that Philip Calthorpe Esquire has made an obstruction with a great bank to the main channel between Cleye and Wyveton within the liberty of this Court of the Port along which channel ships since time immemorial have been wont without hindrance to sail from the town of Wyveton to the sea and from the sea to the Town of Wyveton and to load and unload their goods and chattels, and also another navigable channel† in Cley within the jurisdiction of this Court called Howgate Crick to the great injury and prejudice of the inhabitants of the towns of Cley and Wyveton and navigation there."

Here follow records of a few minor offences which may be given in parenthesis to show with what matters this small court dealt :—

"Thomas Welch removed certain pieces of wood from the channel to the damage of the banks—fined 3d., to replace stakes within 10 days.

---

* Grandfather of Admiral Sir Cloudsley Shovell.

† In those days the Channel divided into two by Cley Quay and did not join again till somewhere near the church.

Richard Woollver threw his anchor in the channel as far as a piece of floating wood called ' a boye,' which he ought not to do—fined 3d.

William Girdleston threw his anchor into midstream which he ought not to do—fined 3d."

Armed with the verdict of the juries of the Admiral Court and the Port Court, the inhabitants of Cley and Wiveton laid their grievance before the King by means of a Petition, which with the depositions is still preserved at the Public Record Office. It is of sufficient interest to be published at almost full length.

" To the Rt. Hoble the Lords of his Maies Noble Privie Councell presen these sent by

J Palgrave
Tho Windham
Phill Colby.

1. The antiquities of the haven appeareth by the Statute made the 31 Edw. 3.

2. That the same haven is sufficient to harbour shipps trading along the coast for safetie off life and goods in extreamitie appeareth for Thomas Saxsames *alias* a Dane on 10th April, 1638 being laden with 44 horses fit for His Majesties service and being ready to perish he with company shipp and goods was preserved, the shipp called the Jonas of Houson whereof ffredrick Declesse was master all which had perished had they not in this haven been preserved for they were bound Eastwards and there is noe haven nearer then Yarmouth eastward which is about 30 miles distant.

3 That the same haven have had many good shipps of burthen belonging to it which have been set forth from thence to Westmonie and Island and to trade with Holland fflanders ffrance and Spaine and other smaller vessells carrying corne and other comodities to Newcastle etc, and bringing in coales salt and other merchandise for the countrie hereabout and likewise to the advantage of His Majesties customs and composition fish. That the ' Susan ' of Wiveton was pressed in Queen Elizabeth's service in 1589 for service into Portugal of which Thomas Coe of Claye went as Quartermaster (as he doth testifie). Thomas Coe affirmeth that they have 19 other good shipps, some of 140 and one of 160 tons belonging to the same towne (six beingbuilt at Wiveton near unto the main channel beside many others belonging to Cleye) by means of which his late Majtie King James of blessed memorie did receive for customs in one year £420 and now his Majtie (Charles) only £100.

Notwithstanding one Sir Henry Calthorpe decd, Mr. Phillip Calthorpe and workmen have erected one wall or banke of earth over two navigable channells the one in Cley the other parting the towns of Wiveton and Cley which taketh away the passage of shipps

and small vessells from the town of Wiveton wholly and partlie from the town of Clay and also doth out of the indraught of water 80 rodds and upwards in breadth and one myle at least in length south of the wall or bank aforesaid so that what sylt or mudd the fflood tide bringeth in doth settle and remaine in the common navigable channell lying along the keies of Cley through want of the ebbtide which formerly overflowed the aforesaid 80 rodds of ground in breadth and 1 myle in length. That the maine channell north of the said Bank is already groune up and landed 2 foote at the least as appeareth upon view to your worships. That the banke doth annoy the channell of Clay and stop the passage to Wiveton as was testified at the Admirall Courts holden at Clay on 31st Jan 1637 and 22nd Oct 1638 by 46 men (12 of Blakeney 6 of Wiveton and 8 more maisters-to-sea and many of them tenants of Sir Henry Calthorpe—also as testified by 21 men at a general Porte Court of Cley and Wiveton holden at Clay on 11th Dec 1638. Which said banke if it be not timely taken away and the grievance prevented will utterlye destroye the haven to the great prejudice of his Matie and his customes and composition fish, the destruction of navigation in the porte and the utter ruine of trade and tradesmen of Clay and Wiveton and great prejudice of the Country adjacent "

The Petitioners then estimate the damage by a comparison of the trade in 1637 (the same year the banke was made) with 1638 :—

1637—1053 chaldron of coales (Newcastle measure) imported
—614 lasts of corne carried out

1638—538 chaldron of coales
—226 lasts of corne carried out

1637—349 weights of salt imported

1638—324 do.

From this it is calculated that the reduction of porterage was £36 10s. 6d.—' the amount the poore porters lost ' and if the poore lost soe much it may be considered what the merchants maisters and mariners and the rest of the inhabitants were damnified.

That the country for want of coales etc were enforced to give farr greater prices than they formerly had done or to seek to further places to their great damage.

That one master of a shipp cannot hire his company this year because the men though the same as last year claim greater wages because their labour has been augmented by lightering up their coals they brought home, and he has been forced to go elsewhere for a crew.

That whereas in 1637 30 entries of ships are recorded in the customs house records only 14 made entry in 1638.

Additional note of evidence submitted by Wiveton witnesses signed by each.

ROBERT HILL testified that " before the maine channell was stopped by the banke my coale and other comodities were brought up neare my gate and bearers did carry them in to my house at 4d or 6d per chaldron without carting them, that the poor have now

to go to Cley or Blakeney for coals and to buy them by the bushell and for need thereof they have broken down many hedges notwithstanding the mildness of last winter"

MARY RINGALL testified that a boate with some 30 chaldron of coales came up in a lighter for her expense and her neighbour Goodman Williams before the banke was erected and then she bought these for 12/8 per chaldron, but now for 17/6 "and the banke hath almost impoverished" her for she "was wont to make 7 or 8 bedds on one night" and now she makes "but one in one night for strangers."

ELIZABETH EGMERE says that she sent "her biskets by boats bringing in coals by a main creek issuing out of the said channell and has now no way of carrying them."

I suspect Mary Ringall kept a lodging house. The necessity of having to provide half a dozen beds nightly for seafaring visitors to Wiveton is a good indication of the thriving maritime trade of those days.

The result of this Petition apparently was that the bank was demolished and the tide flowed once again past Cley "Key" to and beyond Wiveton Bridge. It is possible that, thus thwarted from his purpose to embank the sea out of the Glaven Valley by a short bank between Cley and North Wiveton, Philip Calthorpe proceeded to erect the long semi-circular sea-wall now enclosing the Blakeney Marshes and Golf Course. The actual date must remain in doubt until the Calthorpe Papers now in Hampshire have been inspected.

The date on which the Cley Marshes were embanked remained uncertain until quite recently. Col. E. A. Bulwer, of Heydon, found among his papers and gave to me a deed already referred to, which was the marriage settlement between Symon Britiffe, son and heir-apparent of Edmund Britiffe of Baconsthorpe, and Hester Harbord the daughter of Sir Charles Harbord of The Moore in Herts. It is dated the 11th March, 1651, and by it Edmund Britiffe, the Lord of the Manor and chief landowner in Cley, settled upon himself and his bride the Cley Estate including the greater part of Cley Marshes, which are described in some detail. In this description the marsh is referred to as "ye *late* embanked marsh of ye said Symon Britiffe." We may assume, therefore, that these marshes were drained and enclosed by Simon Britiffe about 1650. It is not unlikely that Van Hasdunck and his men first embanked Salthouse and Kelling Marshes, and then directed their attention to

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Morden's Map (1698) showing Blakeney (A) and Cley (B) Marshes embanked

BANK

Cley from Blakeney Hill, showing the 1823 Bank which is the probable site of the Calthorpe Bank of 1637

Blakeney and last to Cley. He seems, however, to have been a prominent Royalist. He was in Elizabeth Castle in the Isle of Jersey at its surrender to the Roundheads, and his property was sequestrated. It consisted only of twenty-two acres at Thornham East, in Norfolk, which may have come to him as pay for some embanking operations there. In 1646 he apparently compounded with a fine and regained his property. His Royalist proclivities may have made him unpopular in a district predominantly Parliamentarian, and they may have jeopardised his retainer as drainage expert at Cley.

To anyone planning the embanking of the Cley Salt Marshes the Eye would seem an obvious pivot, as not only is it at the north-west extremity but its natural elevation would obviate a bank to the extent of its breadth. So it was. Britiffe erected his bank from his " capital messuage late ye said Robert Beales," now the Old Hall, and thence northwards abreast the Cley Channel to the west side of the Eye and thence from the east corner of the Eye along the Salthouse Channel to some higher land at the N.E. corner and thence by the straight and existing East Bank back to the uplands. I suspect that the present reed beds, the haunt of duck and snipe, mark the site of the old creeks, which intersected the marshes in their tidal days. This embanking did not interfere with the navigable Salthouse Main Channel, which at that time ran north of the marshes towards Salthouse, and there is no evidence that Britiffe experienced the same kind of opposition as was offered to the Salthouse embankment and the Calthorpe enterprise. He was merely enclosing his own property, and in so doing obstructed no one's right of way.

For about two hundred years Cley marshes remained unaltered, providing excellent pasturage for local flocks and herds and possibly wild-fowling. The sea was, however, encroaching, and the beach was being pushed back on the north at the pace estimated at about one yard a year, and by 1850 the channel to Salthouse was to all intents and purposes blocked with shingle preventing the outflow of fresh water from the Salthouse and Kelling marshes. The late Mr. C. J. Temple-Lynes, of Blakeney, who died in 1926, aged 83, used to say he remembered as a boy sailing from Cley channel into

Salthouse Broads at the N.W. corner of Salthouse marshes. This blockage caused the Salthouse marshes to become water-logged, and in 1855 a new embankment scheme for Salthouse and Kelling marshes was carried through, whereby the sea wall (now much breached) was erected the whole way along the coast from Weybourne, and an outlet for the fresh water was found by driving the " main crick " through Cley marshes into Cley channel. In 1861 this new bank broke, and Salthouse marshes resumed periodically their previous sodden condition. This in recent years became much aggravated, because Cley channel itself silted up and the level of the channel bed had became too high to permit any appreciable outfall from the main creek through Cley marshes. In 1924 a new channel was cut on the Blakeney side near Blakeney chapel. This has helped considerably the drainage from the main creek at low tide.

Since the beach was driven up against Cley marshes, the danger point has always been at the end of the East Bank at the N.E. corner of the marshes. The storm of 1861 breached the Cley bank as well as the Salthouse sea-wall. The writer's father remembers a messenger arriving at Letheringsett Hall, where the then owner resided, bringing the unwelcome news that the bank had given way. In 1897 the sea broke through again at this spot (see photograph) and the bank was repaired at considerable cost and faced with concrete. This lasted until 1921, when once again the sea overcame the defences, and the owners of the Cley marshes have now retired from the unequal contest. The marshes are likely to become more brackish as time goes on and their water-logged condition makes the draining of the Salthouse marshes more difficult, as the owners of Cley marshes obviously cannot allow Salthouse water to pass, whilst their own marshes are flooded.

The history of Cley embankment would be incomplete if one omitted to mention that where the Calthorpe bank was demolished in 1639 a new bank was constructed under an Inclosure Act in 1823 and the new road between Cley and Blakeney constructed. Hitherto Blakeney was only approached from Cley by Wiveton bridge, though there was some sort of causeway (they probably called it a " carnser ") and bridge near the present road, but this can only have been available

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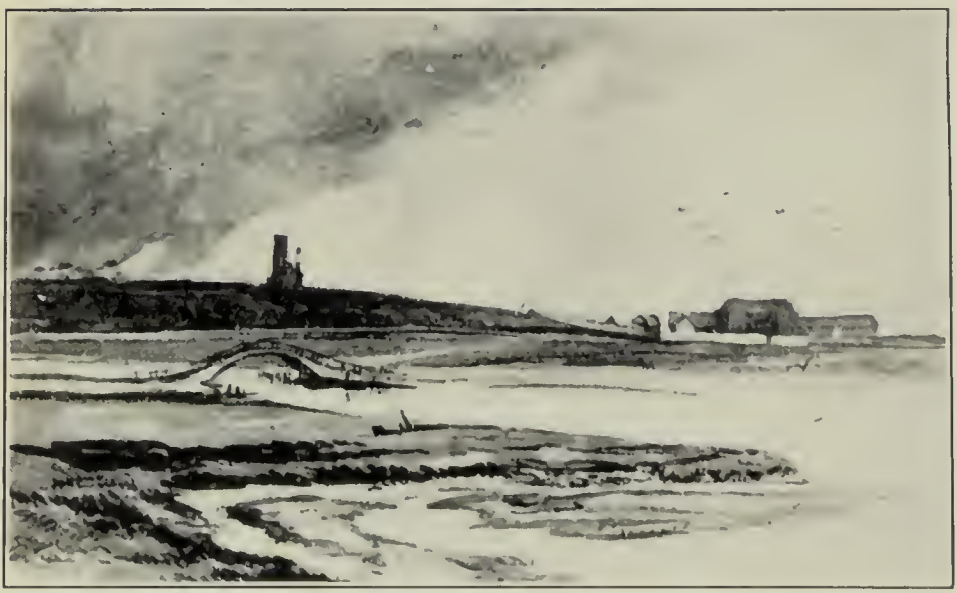
The Breach in the Cley Sea Wall in 1897



View (before 1823) from the old 'George' Quay at Cley showing the Wooden Bridge, Blakeney Church and Wiveton Hall

at low tide. The effect of the bank has been still further to land up the channel by Cley quay, as the scour of the ebb and flow of the tide has naturally been reduced. The more one embanks an estuary the more does what is left become silted up. Only once, I believe, has this bank broken and that was in the 1897 storm above referred to, when the Wiveton Valley became for a few hours a rough sea.

The Wooden Bridge and Great Tides.

The following notes, with the exception of two paragraphs, are taken from some memoranda made in the Cley Parish Register by the Rev. Robert Thomlinson, Rector 1764 to 1801. The wooden bridge was situated very near the present Cley-Blakeney road. An illustration of it is given in this paper. The causeway leading to it may very likely have been what was left of the Calthorpe bank of 1638.

In 1739 a wooden bridge was thrown across the salt marshes to Wiveton which cost 60 or 70 pounds. Patrick Eson, collector of ye Customs, was the undertaker and took great pains in procuring subscriptions for ye same.

17th October 1798 At the Quarter Sessions at Holt the wooden bridge leading from Cley to Wiveton and Blakeney was presented by Mr. Robert Brereton (foreman of the Jury) as being dangerous and ruinous.

24th July 1799 Philip Roome deposed that he remembered the bridge being built by subscription in 1739—kept privately up—never a public right of way.

The Court was satisfied that neither Cley nor Wiveton was obliged to keep the bridge in repair.

HIGH TIDES.

On Sunday night the 15th of Feb. 1735/6, a violent storm arose at North West and continued till Tuesday morning and the Spring tide happening at the same time brought the sea in a most terrible manner upon the Shoar ; so that it overflowed the great Beach at Clay and almost demolished the Town, many of the inhabitants of which were obliged to run up to their upper rooms to prevent their being drowned and were afterwards taken out of their windows by Boats. The marshes thereabouts were overflow'd and nine feet water left in them ; and the whole coast from Cley almost to Lynn was overflowed by which great Damage has been done.

The first high tide I remember was in 1767 ; the banks of both Cley and Blakeney were broken down ; all the fences of the Enclosures next the road leading from Cley to Salthouse were washed down, by which John Thomlinson suffered at least £500. At that time he allowed his tenants £40 damages.

On Jan. 1, 1779 a violent gale of wind with prodigious large Tide drowned the marshes of Cley and Blakeney and did damage to the town, getting into the Malthouses and spoiling corn in the granaries.

1780 Ditches were made to fence the marshes from the road.

30th Oct. 1789 12 o/c in night a sudden and violent gale of wind with a large tide. The tide forced a new ship, called the Abbicore, belonging to John Learner, Merchant, from her moorings & the ship went directly thro' the wooden bridge and half way up the Creek towards Wiveton stone bridge. She was obliged to be dug out & a great part of the Bridge taken down to let the vessel into the course of the Channel. A Subscription was immediately begun towards repairing the wooden Bridge leading from Cley to Wiveton. 50 guineas raised and the bridge put in excellent repair and bank gravelled.

2nd. Feb. 1791. A gale of wind, when Cley marshes were drowned owing to the East Bank being made lower after the Rage in 1779; the water was about 2-ft. on the level on Cley marshes—a hay stack stood in the marshes all the time. The water ran out of Salthouse Channel over Cley East Bank from 7 in the morning till 2 in the afternoon.

Notwithstanding these floods no abatement was ever asked or made in the payment of tythe.

R. Thomlinson, Rector.

An Account of extraordinay high tides, commonly called "Rages" in Cley and Blakeney :—

Nov. 25, 1665	Feb. 28, 1749
Oct. 8, 1690	Jan. 2, 1767
Feb. 16, 1735	Jan. 1, 1779
Feb. 7th, 1741	Feb. 2, 1791
Dec. 12, 1744	

There appear to be about 8 Rages in 100 years.

Trade of Cley.

Before the advent of railways and while coastal trade was carried only by small sailing ships, the three towns of Blakeney, Cley, and Wiveton had always a considerable trade. Cley's trade decline in recent years has no doubt been accelerated by the silting up of the channel. Old inhabitants have told me that they remember seeing a long line of farm waggons filled with corn extending from the quay as far as Town Yard waiting to unload into ships lying at the quay. The photograph printed with this paper of a ship unloading near the windmill quay was, I am told, taken in the seventies.

Cley was probably at the acme of its prosperity in the XIVth Century, when its church was rebuilt. Norfolk produced

what the Low Countries wanted, and a coastal town with a good haven was bound to be busy with the exportation of wool. It must indeed have been the staple trade of the port, and it did not suffer decline until East Anglia began to acquire skill at weaving under the tuition of the Strangers. This tended to keep the raw wool at home for manufacture.

The earliest reference to the port and its trade is a verdict in 1285 of the Jury of the Cley and Blakeney *alias* Snitterly* Ports. They say on their oaths that the ports belong to lords of the manor and their liberties and right to wreck extend from Hancon-ketil† in Morston to Carwell‡ mill and the liberty of free warren extends from Benesherd‖ to Roger Agges Gate in Salthouse. All ships that enter the port and buy or sell or dry their nets or spread them at the first coming, pay the lord 4d., and so every year 4d., except the ships belonging to the Cinque Ports, to London, Colchester, Rochester, " Maydenston " and Yarmouth, which are all free. Every herring cart pays 1d. a thousand carried out. Every ship belonging to Snitterly pays 60 custom herrings a year to the lord. All things both in the ships and out must be measured by the lord's measure. Every pack of wool brought in or carried out of the port pays 4d. No bailiff can enter the Liberty of the port to take distresses, except the lord's bailiff, neither can anyone within the liberty carry a mace or any ensign of authority without the leave of the lord or his bailiff. No coroner can enter to sit upon any one drowned or murdered. The lords constantly hold their Court from Tade to Tide.§

Many of the early records which survive relating to trade are connected with the compulsory purchase of supplies for the Army in France and the 'indent' on Cley was usually for salt fish. Salt for this purpose was no doubt imported, but it was made in small quantities in Cley. The hollow marsh at the S.W. corner of the Trust's property not far from the Windmill, is still called the Saltpan. In a deed of 1721 it is described as " ground formerly used for saltpanns

* Snitterly was the name of a village by Blakeney, now disappeared.
† There is a Kettle Hill in Morston.
‡ There is still a Carvel Marsh in Kelling.
‖ This was in the Channel leading to Blakeney quay.
§ I have no explanation to offer about the meaning of this phrase.

or salt works." Being near the channel the water could easily be let in by a sluice as and when required. The following is an extract from the Register of the Black Prince :—

EXTRACT FROM REPORT OF BLACK PRINCE.

On May 20, 1351, there is an order to Thomas Storm of Blakeneye and to the bailiff of the Haven of Blakeneye reciting that whereas he needed :

" A great number of salt fish for the victuals of our household this next voyage across the sea for the war and our Sergeant Thomas de Sandewyc, acatour of our household, whom we have sent to Saint Botolf (Boston) to make purveyance of stokfissh for our use for the said voyage cannot quickly get to your parts to get the said fish We trust to you to get for us in the towns of Blakeneye, Snyterleye, Wyveton, Clay, Salthous, Shiryngham, Welles, Crowemere, and other neighbouring ports, both within and without the franchise, and to seize to our use to the number of 1200 lobbe being talcod and other kinds of salt fish and to have them kept until the arrival of the said sergeant."

Years later, in 1523, provisions were shipped from here by Cardinal Wolsey's Order to Calais for the army and navy. They included 'dried cod bought from Wm. Momfort of Cley at 45s. per 100.'

In Queen Elizabeth's time the exigencies of naval defence necessitated frequent naval musters. It is difficult to realise that the Royal Navy at the time of the Armada consisted of 28 sail, mostly small, and these were starved in munitions and supplies by the Queen's parsimonious policy. Reliance had to be placed upon merchants and their ships, never without some armament in view of the constant menace of pirates who abounded particularly on our East Coast. Amongst the Domestic State Papers of James I. there are two interesting letters of 1619 about pirates. Apparently an order had been issued to raise £200 locally for suppression of these pests. The Yarmouth Bailiffs beg relief, though willing to do what they can, but are heavily burdened with charges of piers and haven. Accompanying this letter is another from the inhabitants of Cley, who are the only people on the coast who " send their free contributions though very poor."

The following Muster Roll for 1570 is valuable as it gives some sort of comparison between the Norfolk Ports :—

" Names of mariners and all ships above 30 tons certified to the Rt. Honble. Lords of the Council by Sir Thomas

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Ship at Cley Quay near the Mill, about 1875

Cley Quay, about 1900

Woodhouse Knight and Henry Woodhouse Esquire Vice-Admiral there."

The list can be summarised thus :—

	Ships.	Mariners.
Lynn	24	141
Holme	2	9
Welles	10	69
Blakeney	11	52
Wyveton	8	43
Clay	13	65
Salthouse	—	38
Kelling	—	5
Waborn	4	17

The Cley ships, given by name, consisted of 3 of 100 tons, one of 90, one of 80, and the rest smaller down to 30 tons. Small indeed they seem to us, but the Pelican, in which Sir Francis Drake sailed round the world in 1572, was a brigantine of only 120 tons. The Pilgrim Fathers' Mayflower was but 140 tons.

What is really surprising is the size of the ships belonging to this Haven in 1582 compared with those of the other larger Norfolk Ports :—

	Ships of 100 tons or over.
Cley	2
Wyveton	4
Blakeney	1
Lynn	2
Yarmouth	4
Welles	3

The trade which these merchantmen carried on when not engaged in fighting the King's enemies, regular and irregular, was chiefly, certainly in the middle ages, the export of wool and corn to the Low Countries, and the import of manufactured goods from the Continent. I have an original letter dated 1587 addressed by John Braddock, a merchant at Wiveton, to Sir Nathaniel Bacon of Stiffkey, stating that a ship had just arrived from Hamborow* with some Spanish salt and

* Hamburg.

pipes of oil and also " dry ffatte " and " babies and rattells for children with many other such trifles which come from Germany." Even in those days the Germans were apparently adept at making dolls. There was also a considerable trade with Iceland, or " Island " as they spelt it, in connection with, probably, the whale fishery.* They used to classify ships as " Island ships." With regard to local fishing, one of Blomefield's correspondents says in 1735 that " the Harbour is noted for fish called smouls, and that the fishermen have the liberty of fishing with a canvas net having a coat of mail at the end."

By the XVIIth Century, coastal trade appears to have become more important than foreign trade. The Petition of 1638 quoted above gives a good idea of its dimensions. Grain was sent north in large quantities. Indeed in 1631 Cley's export trade caused resentment in Norwich. The City Fathers complained officially to the Privy Council that the number and the misery of the poor of the City had so increased that the petitioners had been obliged to put upon themselves and the better rank of citizens treble as much as they formerly paid, and all citizens twice as much. They had borrowed £300 to disburse in corn for the poor, while exportation of corn was still carried on at Wells and Cley under a licence from the Privy Council, which they prayed might be recalled.

The ship that took corn to Newcastle brought back coal. Cley was probably the coal emporium for North Norfolk. It must be remembered that until the advent of railways practically all coal was sea-borne It could come in no other way. That is why it used to be called " sea-coal " to distinguish it from the other form of coal—charcoal.

There was an interesting Memorial in 1728 from the Merchants of Cley to the Board of Customs protesting against the proposal to confine the lading and unlading of ships to a new and inconvenient ' Key.' In the course of this Memorial they give details of the staple trade, " from whence great quantities of Malt and all sorts of Corn and Grains and divers goods and merchandize have been from time to time exported and great quantities of Coals, Iron, Fir, and other Timber, Deal, Tiles, Stone, Salt, and other merchandize imported."

* There are whalebones used as posts outside the Manor House at Cley.

Now, alas! Cley's mercantile glory has vanished. The channel is 'landed up' and the quays deserted. The granaries have been converted into cottages or garages, or have been pulled down. The old Customs House is still there, a charming little house to testify to the town's erstwhile trade. But Cley still attracts the fowler, the naturalist, and the artist. May they combine to prevent its gradual vulgarisation by petrol pumps and stucco.

XII

ADDITIONS TO THE NATURAL HISTORY COLLECTIONS IN THE NORWICH CASTLE MUSEUM DURING 1926

By F. Leney, Curator

The Collection of British Birds has been greatly enriched during the year under review through the generosity of the late Mr. Francis Allen and of Mr. B. B. Riviere. The birds in the Francis Allen Collection were all obtained on the Cockley Cley estate near Swaffham and are shown in their natural habitat in lightly constructed glass cases. The various groups are very effective and are remarkably good examples of Messrs. Rowland Ward's work in taxidermy. Special mention must be made of the cases of Teal, Mallard, Pochard, Golden Plover, Norfolk Plover and the Sparrow Hawks. One large case shows a group of the various species of Corvidæ, viz., Jackdaw, Rook, Hooded Crow, Carrion Crow and Magpie, an admirable piece of work of educational value.

Mr. B. B. Riviere's collection includes some of the rarer British birds taken in Norfolk, as for instance the Spoonbill, the Avocet, the Greenshank in winter plumage, the Shore Lark and the Little Gull. Mr. Riviere has also most generously presented his collection of British birds' eggs, as the exhibited series at the Museum had lost their colour. Clutches of eggs of nearly all the birds which breed in Norfolk are included in

the collection, together with a Catalogue giving the full data for each species, and it is the intention of the donor to add to his gift as opportunity occurs.

The Castle Museum Committee greatly regrets that it is impossible to exhibit the various collections of British birds which have been presented or bequeathed to the Museum during recent years, such as those from the Rev. Maurice Bird, Mr. Christopher Davies, Mr. W. J. O. Holmes, and Mr. Gerard Gurney. A Sub-Committee has been appointed to prepare a scheme for re-organising the arrangements for exhibiting the Bird Collections, and it is hoped in the near future that this section of the Museum will be brought into line with modern methods of classification and arrangement

Foreign birds include skins of the rare Pteronetta Hartlaubi from Egypt (sent with full data of size, place, etc.) ; mounted specimens of the Avocet and the Oyster Catcher from West Africa ; an Egyptian Goose taken in Norfolk ; a mounted specimen of the beautiful Lady Amherst's Pheasant ; also a male Rhea in full plumage which died in captivity at Keswick, and was mounted under Mr. Gerard Gurney's superintendence. Skins and eggs of both the Antarctic Penguin and the Gentoo Penguin were received from the Graham Land Expedition of 1920-22, and a small collection of bird skins from El Mansura, in Egypt. Difficulty has been experienced with H.M. Customs in the matter of birds sent direct to the Museum from abroad, and in some instances the specimens were held up for weeks in connection with the regulations of the Plumage Act.

The Mammalian Collection has received the addition of a Blackbellied Wallaby and a Marmoset, both of which died in captivity, and several small British Mammals. Through the kind offices of Mr. Robert Gurney, the Trustees of the British Museum presented a series of specimens of Crustacea and it is hoped to provide an instructive Index Collection to this little known group of Invertebrates.

Various publications relating to Natural History subjects have been received from the British Museum, the United States National Museum and the United States Bureau of Fisheries.

XIII

OBITUARY

FREDERICK LONG, M.R.C.S., L.R.C.P.

1840—1927

We regret to have to record the death of Mr. Frederick Long, which took place on 23rd February, 1927. A member of this Society since 1881, he was elected President for 1903-4, and was made a Vice-President in 1923. His interest in botany commenced at an early period in his life, and he found plenty of material at Wells-next-the-Sea and the district, where he carried on his medical practice till 1899, when he retired and came to live in Norwich. However, on relinquishing his practice, he continued his botanical researches in Norwich and the neighbourhood, and other places, with possibly even greater assiduity. He visited Madeira and Zululand in 1916, and brought back collections of Grasses from both these regions. Mr. Long's most important discovery was that of *Sonchus arvensis* L. *var. angustifolius* Meyer, in 1822. This was an addition not only to the Norfolk list, but the first record for the British Flora. It was first found at Wells, and seems to be a maritime variety. It is mentioned in Mr. Long's first contribution to the Norfolk and Norwich Naturalists' Society's Transactions in February, 1887 (vol. IV. p. 371, " Rare Plants from Wells and neighbourhood "). Other additions to the Norfolk County list included the following :—*Poa subcoerulea* Smith, Wells, 1906 ; *Bromus erectus* Huds. var. *villosus* Bab. near Holkham ; *Glyceria distans* Wahlb. var. *pulvinata* Fries. Wells. This grass was examined by Mr. Arthur Bennett, who gave his opinion upon it, and considered it the Scandinavian variety, so named. *Festuca rubra* L. var. *grandiflora* Hack. *f. littoralis*. This was a marsh grass growing at Wells, subsequently named by Prof. Häckel. *Trifolium pratense* L. *var. parviflorus* Bab. first found at Stiffkey, and recorded in our Transactions in 1887. *Cardamine pratensis* L. *var. palustris* Peterm, found at Arminghall in 1903. *Lavatera cretica* L. Sheringham, 1921.

In 1903 Mr. Long read an interesting paper on the result of his observations on "The Thick Adventitious Growth on the Boughs and Trunks of our Forest Trees." This thick growth of foliage he had noticed for several preceding years, and attributed it to the remarkable cold blast which swept over the country on 16th May, 1895. The gale blew from the N.N.W., and was accompanied by sleet and hail. The Oaks and Elms, which had just come into leaf were unable to resist the cold blast, and the leaves were all destroyed. Later on, a fresh crop of leaves appeared, accompanied by an abundance of adventitious shoots along the branches, giving them a fringed appearance. With reference to this storm, Mr. Preston, in his Meteorological Notes for 1895, remarks, "The young foliage on the north sides of trees was torn to shreds and blackened, and in many instances, never recovered throughout the summer." This paper shews Mr. Long's keen interest in the varied aspects of trees, of which he was very observant.

His paper on the "Protection of Plants" which was read to the Society in 1903, when the subject was much discussed, contained several good suggestions, being written in no fanatic spirit, and marked by strong common-sense.

During his residence in Norwich, he took great interest in the botanical collections in the Castle Museum. He compiled a M.S. catalogue of the Salmon Herbarium, bringing up the nomenclature to that of more recent times.

In the meantime, however, he was assiduous in keeping up, and adding to his own herbarium. Most of the specimens, nearly 2,000, were, if not absolutely collected by himself, certainly mounted by him. A certain number were sent to him by the Watson Botanical Exchange Club, of which he was a member, and the mounting of these, with a little help, occupied him almost to the day of his death. The collection is fairly representative of the Flora of the British Isles. It is a matter of congratulation to the Castle Museum, and to Norwich, that these collections were bequeathed to the Norwich Museum.

He was a regular attendant at the meetings of the Society, where his knowledge of botany was frequently called upon, and his genial and kindly manner much appreciated.

SIR DIGBY PIGOTT, C.B.
1840—1927

Regret will be felt by many at the death of Sir Digby Pigott after a long career of usefulness in official life. First appointed to the War Office in 1859, he served as private secretary successively to Lord Northbrook, Lord Lansdowne, and Lord Cranbrook. In 1877 he was made Controller of the Stationery Office by Lord Beaconsfield. In 1888 he received the additional appointment of Printer, under letters patent, of all Acts of Parliament, and held in that capacity the copyright in all government publications. As Queen's Printer he was responsible for the production of the official Reports of the Challenger Expedition. These Reports consist of 50 volumes and were printed in 1880-1895. The supervision of them brought him into contact with many of the foremost scientific men of the time.

He received the honour of C.B. in 1890 and was knighted on his retirement in 1906. In Sheringham, where he resided after his retirement, he found a suitable locality for his ornithological and literary tastes. He joined our Society in 1892, and was also a member of the British Ornithologists' Union. He contributed occasionally to the Contemporary Review and to Blackwood's Magazine, and was the author of several books dealing chiefly with natural history. In 1883 he brought out a small book entitled "London Birds and London Insects." This was an amplification of articles previously published in various magazines. That portion of the book which deals with the insects of London consists not only of a fascinating view of a class of living organisms some noxious and some beautiful, but also really forms a very good introduction to the study of entomology. The book is enriched with many quotations from the classics and from modern writers. Other publications of his were "Tommy's Adventures in Natureland," and "The Changeling."

JOHN HENRY FRASER WALTER
1847—1927

By the death of Mr. Walter on July 16th, 1927, the Society loses a former President who had been a member since 1875.

Though his main interest was Archæology, he did not neglect natural history. In the course of his life he had travelled extensively, not only in Europe, but in the United States, Canada, Egypt, Algeria, and Morocco. In April, 1897, he read before the Society a short paper on "A visit to an Egyptian Ostrich Farm," and, for his Presidential Address in 1915, he chose for his subject the collection of birds' eggs formed by his father, Henry Fraser Walter. This address included an interesting account of the eggs of the Great Auk and other rarities. Mr. Walter always took a great interest in the Norwich Museum, on the Committee of which he served for 34 years. In 1921 he founded a society known as "The Friends of the Norwich Museum" with the object of enriching the collections by the purchase of objects which the limited funds of the Museum would not allow the Committee to obtain. A keen collector himself, with a rare knowledge of various branches of art, Mr. Walter was able to offer to the Museum, either as his personal gift, or as a gift from the "Friends," many most valuable treasures. He will be much missed in Norwich as a good public speaker, but not least for his kindly manner which never failed to attract.

R. J. HOWARD

1852—1927

We have also to record with regret the death of Mr. R. J. Howard of Blackburn, a well known ornithologist and a member of our Society since 1887. He was a member of the British Ornithologists' Union, and was looked upon as a recognised authority on birds, not only in his district, but over a wider area. He took a keen interest in the Blackburn Museum, superintending the whole of its mammal and bird collections. He assisted in the production of Mitchell's "Birds of Lancashire" and "Birds of the Stonyhurst District." The 2nd edition of the former work was edited by Howard Saunders, who testified to Mr. Howard's valuable assistance in bringing it out. He was on terms of warm friendship with A. Thorburn who submitted most of the sketches for the "Book of British Birds" to Mr. Howard before publication.

To the Blackburn Public Library he rendered very useful services. His first association with it began in 1874. In 1915 he became Chairman, a position which he occupied till his death. He was made a vice-president of the Royal Lancashire Agricultural Society in 1915, in recognition of his valuable services to agriculture.

W. A. N.

XIV

MISCELLANEOUS NOTES AND OBSERVATIONS

The Large Copper Butterfly—(*Chrysophanus rutilus*).—The attempt which was made last year to introduce the Large Copper Butterfly into some of the Norfolk marshes has unfortunately not met with the success which was hoped for. This is primarily due to the lack of sun and warmth, and to the large amount of wet, cold weather there has been during the past summer. As I stated in the account published in our Transactions for 1925-26, nearly 550 butterflies were liberated at Woodbastwick during July, 1926, and about six weeks later some 150 larvæ were counted, ready to go into hibernation for the winter. This season a very few full fed larvæ were noticed on May 24th, also pupæ. The first one hatched on June 27th, and the last on August 2nd, but hardly any imagines were seen, and no ova at all have been found ; so that unless more pupæ are put down early next summer, it is obvious the species will have entirely disappeared. It is especially unfortunate that the weather conditions should have been so against them in the first year of the attempt.—Gerard H. Gurney.

A Distinctive Characteristic of Sonchus Palustris.—The accessible descriptions of the species of *Sonchus* are not sufficiently explicit, or there would be fewer cases of examples of varieties of *S. arvensis* being wrongly reported as *S. palustris*.

The rarer species is probably not as uncommon as it is generally supposed to be. Confidence may mislead a few, but caution deters more. An isolated plant should be regarded with suspicion—for where *S. palustris* does occur it will generally be found in crowded groups.

Having once been seen at home and recognized, *S. palustris* presents many points which distinguish it from *S. arvensis*, the trouble is to describe them in intelligible terms ; however, the following is offered as a reliable method of identification.

Cut a longitudinal section of part of the stem of the plant in question. If it is a tall example of a variety of *S. arvensis* the stem will generally, but not invariably, be found to be hollow, and the stem wall will show only a thickening at the nodes ; the hollow, wherever present, is a continuous one. *S. palustris* has a thin-walled, hollow stem, and invariably the hollow is interrupted at the nodes by thin septa. Each septum is well defined and the section is similar to that of a " bamboo " with very short internodes.

The ripe achenes of *S. palustris* are a little more deeply furrowed than those of *S. arvensis*, and their attachment to the pappus much less firm ; this last point may be one in favour of the plant's survival, for the seed is not carried far away into what might be unsuitable surroundings.—P. E. Rumbelow.

Albino Rats.—Two pure white examples (male and female) of the Brown Rat were brought to me by a Taverham rat-catcher in March, 1926. Rats which are partly white, usually very large specimens, are often met with in stacks.

Abnormal Skate.—In January, 1925, I met with a Thornback ray (*Raia clavata*) with a perfect fin, the size of my hand, standing erect upon the centre of the back, parallel to the backbone of the owner. It was probably more of a hindrance than a help to the fish. In all my experience I have only met with one other similar malformation in the Skate family, a Ray having two small fins, which had a tendency to affect a horizontal position. This was in July, 1892.

Food of the Sturgeon.—It is my experience that it is seldom that a Sturgeon's stomach is found to contain any quantity of food; here and there a few crustaceans are discovered, and in the intestines some amount of sand ; but in June, 1927, I had the good fortune to examine a freshly caught Sturgeon, measuring 4-ft. 6-ins., and weighing 26-lbs. I was curious to see if its stomach contained food of any kind, and asked the fish merchant who was exhibiting it to oblige me with its stomach.

He weighed it with its contents which scaled 15 ounces. On emptying the stomach into a dish, I took $13\frac{1}{2}$ ounces of lesser sandlaunces of some $2\frac{1}{4}$ inches length. Finding 54 fishes to the ounce, I found I had some 729 in all. Next day I was assured that quite a number of these fishes were discovered in the passages leading into the stomach.—ARTHUR H. PATTERSON.

ESTUARINE SHELLS IN THE BEDS OF EAST NORFOLK RIVERS.—In the Transactions, Vol. VIII., p. 855, I recorded the finding, in dredged mud at Ludham Bridge, of shells of Cockles, *Scrobicularia piperata*, and *Tellina balthica*. During the past summer Dr. Hankin showed me specimens of the two former species which he had found in mud dredged from the Hundred Stream near the entrance to Kendal Dike, and he subsequently found them also in 13 out of 15 localities visited along the Thurne River. It is of much interest to find that these estuarine species occur also so commonly in the Thurne. The appearance of the shells leaves no doubt that they actually lived in the places in which they are now found. The shells have been submitted to Dr. F. R. C. Reed, who considers that there is no evidence that they could have come from Crag deposits disturbed by the dredger. They must therefore represent, as was originally suggested, relics of the ancient estuary which occupied these valleys up to historic times.—ROBERT GURNEY.

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1927–28

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1921 Bignold C. R., Loddon House, Loddon, Norfolk
1895 Birkbeck H., High House, Westacre, Norfolk
1901 Birkbeck H. A., King's Lynn
1921 Birkbeck Oliver, Little Massingham House, King's Lynn
1926 Birkin H. R. S., Tacolneston Hall, Norfolk
1925 Blofeld T. C., Hoveton House, Norwich
1885 Boardman E. T., How Hill, Ludham, Norfolk
1927 Boardman C., How Hill, Ludham, Norfolk
1896 Boileau Sir M. C., Bart., Ketteringham Park, Wymondham, Norfolk
1902 Booth H. B., Ryhill, Ben Rhydding, Yorks.
1925 Borley J. O., O.B.E., Marine Biological Laboratory, Lowestoft
1924 Boyd A. W., Frandley House, Near Northwich, Cheshire

Elected.

1915 Bradfer-Laurence H. L., F.S.A., King's Lynn
1923 Brereton Mrs., Gresham, Holt
1928 Briscoe Lieut. F. M. Eliott-Drake, Britannia Barracks, Norwich
1884 Brittain H., 1, Fairfield Road, Town Close, Norwich
1924 Britton Eric, 43, Cambridge Street, Norwich
1924 Broderick Miss, Cathedral Close, Norwich
1912 Brooks J. R., North Walsham Wood, Norwich
1925 Brooks Mrs., North Walsham Wood
1925 Brooks Miss Nancy, North Walsham Wood
1926 Brown Miss I., Walton Lodge, Surlingham
1927 Brown Miss V., Walton Lodge, Surlingham
1921 Brown Mrs Du Puis, Chedgrave Manor, Loddon
1921 Bruton M. S., The Post Office, Aylsham
1925 Bryan H., "Lanthwaite," Eaton, Norwich
1926 Bullard, E. J., Heigham Grove, Norwich
1922 Bulwer Lt.-Col. E. A., Heydon Grange, Aylsham
1925 Bulwer Mrs., Heydon Grange, Norwich
1926 Bullard Ernest, Swan Cottage, Horning, Norwich
1923 Burnand L. B., Bushy Place, Aylsham
1895 Burrell W. H., F.L.S., "Bracondale," Hall Lane, Leeds
1923 Burton Arthur, M.D., Cromer
1923 Burton Mrs. Arthur, Cromer
1882 Burton S. H., F.R.C.S., St. Giles Street, Norwich
1927 Burton-Fanning F. W., M.D., 90, Newmarket Road, Norwich
1928 Bushell Maurice D., Bolwick, Marsham, Norwich
1925 Busittil F. P., Swardeston, Norwich
1900 Bussey A., Wayford, Stalham
1926 Butler S., Lime Grove, Lime Tree Road, Norwich
1921 *Buxton Anthony, Knighton, Buckhurst Hill, Essex
1884 Buxton A. F., Fairhill, Tonbridge
1887 Buxton E. G., F.Z.S., Catton Hall, Norwich
1874 Buxton Geoffrey F., C.B., F.Z.S., Hoveton Hall, Norwich
1923 *Buxton Major Ivor, Little Dunham, King's Lynn
1906 Buxton R. G., Petygards, Swaffham, Norfolk
1906 Buxton W. L., Bolwick Hall, Marsham, Norwich

C

1909 Calvert E. M., Eaton, Norwich
1909 Campbell-Taylor J. E., Barclays Bank House, Pembroke Dock
1925 Canterbury Viscount, Bergh Apton, Norwich
1923 Carruthers Douglas, Barmer Hall, King's Lynn
1907 Caton Rev. R. B., Great Fakenham Rectory, Thetford
1902 Cator John, Woodbastwick Hall, Norfolk
1923 Cator H. J., Ranworth Old Hall, Norwich
1922 Cator Miss Diana, Trewsbury, Cirencester
1926 Chadwick Dr. M., 3, King Street, King's Lynn
1911 Chamberlin Rev. C. M., Witton Rectory, Norwich
1924 Chambers Miss M. H., 72, Ditchling Road, Brighton
1925 Charlesworth J. B., Gunton Hall, Lowestoft
1919 *Chasen F. N., The Raffles Museum, Singapore
1924 Chittock A. T., 12, Chapel Field North, Norwich
1924 Chittock Mrs. A. T., 12 Chapel Field North, Norwich
1907 Christie J. A., M.P., Framingham Manor, Norwich
1923 Citters A. van, Broadlands, Wroxham
1923 Claridge Mrs., St. Giles' Plain, Norwich
1925 Clarke Mrs. F., "Coniston," Newmarket Road, Norwich
1927 Clarke Miss L. R., 12, St. Philip's Road, Norwich
1911 Cleather Rev. W. S., Barningham Rectory, Norfolk
1923 Clodd Mrs., Strafford House, Aldeburgh, Suffolk
1925 Cobbold J. D., Holy Wells, Ipswich

Elected.

1887 *Cocks A. H., M.A., F.Z.S., Poynetts, Skirmett, Henley-on-Thames
1909 Coke Right Hon. Viscount, Holkham, Norfolk
1923 Cole Lowry A. C., The Lodge, Sprowston
1923 Cole Mrs. Lowry, The Lodge, Sprowston
1923 Collin J. F., 419, Unthank Road, Norwich
1924 Collings Dr. D. W., The Mount, Southwold
1921 Colman Capt. G. R. R., Bixley Manor, Norwich
1903 *Colman Miss E. M., Carrow Abbey, Norwich
1903 *Colman Miss H. C., Carrow Abbey, Norwich
1881 Colman Russell J., Crown Point, Norwich
1925 Cook G. J., 143, Newmarket Road, Norwich
1925 Cook T. A., Sennowe Hall, Guist, Norfolk
1925 Copeman T. D., The Warren, Reedham
1919 Copeman W. O., 76, Highland Road, Norwich
1923 Coward T. A., M.Sc., Brentwood, Bowdon, Cheshire
1921 Cozens-Hardy A., Oak Lodge, Sprowston, Norwich
1926 Cozens-Hardy E. W., Oak Lodge, Sprowston
1886 Cross J. M., Acle
1926 Cruickshank W. G., 11, Hammersmith Terrace, London, W.C.6

D

1910 Dalby Rev. Alan, M.A., The Vicarage, Leamington-Hastings, Rugby
1922 Dallas Chas. C., Eastley Wootton, New Milton, Hants.
1928 Daniels E. T., 31, Market Place, Norwich
1923 Daukes Maj. A. H., 22, Egerton Terrace, London, S.W. 2
1920 Davey Guy, Aldborough, Norwich
1927 Davies, Miss H., Branksome Road Norwich
1914 Davies H. C., Old Lakenham, Norwich
1901 Day Donald D., F.R.C.S., All Saints' Green, Norwich
1926 Day, J. Wentworth, 61a, Pall Mall, London, S.W.1
1917 Deacon G. E., Brundall, Norwich
1928 Dewing B., Point House, Aylsham Road, Norwich
1891 Digby A., Syderstone, King's Lynn
1918 Donnison H., Boston, Lincolnshire
1916 Doughty Chester G., 7, Upper Cliff Road, Gorleston-on-Sea

E

1911 Easter W. C., 99, City Road, Norwich
1924 Elliott T. B., 8, Brunswick Road, Norwich
1897 Evans H. Muir, M.D., Turret House, South Lowestoft
1919 Evans-Lombe Major E., Marlingford Hall, Norwich

F

1885 Falcon Michael, Sprowston Hall, Norfolk
1927 Fawkes, Dr. R. B., Redc's House, Cromer
1922 *Ferrier Miss J. M., M.B.O.U., Hemsby Hall, Norfolk
1922 Ferrier R. F. E., F.S.A., Hemsby Hall, Norfolk
1924 Fisher K., The School, Oundle, Northants
1923 Fisher Sidney, Oaklands, St. Clement's Hill, Norwich
1924 Fleming James M., " Drumwalt," The Long Road, Cambridge
1880 *Fletcher W. H. B., Aldwick Manse, Bognor
1922 Fonnereau Miss Hilda, The Eyrie, Palling, Norfolk
1924 Fowler Major E., Gunton Old Hall, Lowestoft
1924 Fowler Miss E., Drinkstone House, Bury St. Edmbnds
1922 Frere Sir Bartle H. T., South Walsham Hall, Norfolk
1926 Fuller A. W., 18, Kerrison Road, Norwich

Elected.

G

1902 Garstang Walter, D.Sc., The University, Leeds
1924 Gay Miss Ellen, Thurning Hall, Guist, Norfolk
1927 Gay Miss C. E., Ardleigh House, Hornchurch, Essex
1925 Gay Miss G. A., Ardleigh House, Hornchurch, Essex
1926 Gayner J. S., Hall Cottage, New Earswick, York
1922 Gaze R., 105, Earlham Road, Norwich
1903 Geldart Miss Alice M., Cotman Road, Norwich
1928 George Sydney S., Saham Toney, Thetford
1926 Gilbert Brig.-Gen. A. R., C.B.E., D.S.O., Sprats Green, Aylsham
1926 Gilbert Mrs. A. R., Sprats Green, Aylsham
1908 Gilbert R. T. E., Ashby Hall, Norfolk
1923 Gill S. T., Rupert Street, Norwich
1921 Glover T., Cliff House, Norwich
1909 Goodchild Herbert, The Chestnuts, Unthank Road, Norwich
1901 Goose A. W., 10, Sandringham Road, Norwich
1922 Gossage Mrs., Leet Hill, Kirby Cane, Norfolk
1922 Gossage Col. W. W., Leet Hill, Kirby Cane, Norfolk
1927 Grant E. R., Hotel Roosevelt, Washington, D.C., U.S.A.
1921 Graves Mrs., Oulton Lodge, Aylsham, Norfolk
1919 Greatorex H. A., Witton, Norwich
1924 Green Maj. E. A. Lycett, Ashfield, York
1918 Gresham School The, Holt, Norwich
1913 *Grey of Fallodon, The Rt. Hon. Viscount, K.G., *P.C.*, Fallodon, Lestbury, Northumberland
1926 Gunn F. E., 84, St. Giles Street, Norwich
1918 Gurney Major Cecil F., Berry Hall, Walsingham
1893 *Gurney Gerard H., F.Z.S., Keswick Hall, Norwich
1901 Gurney Q. E., Bawdeswell Hall, Norfolk
1894 *Gurney Robert, D.Sc., F.L.S., *Hon Treasurer*, Bayworth Corner, Boars Hill, Oxford
1918 Gurney Mrs. Robert, Bayworth Corner, Boars Hill, Oxford

H

1924 Hadfield Travers, Stoneleigh, Knutsford, Cheshire
1892 *Haigh G. H. Caton, Grainsby Hall, Great Grimsby
1905 Halls H. H., 130, Hall Road, Norwich
1926 Hammond C. R. A., Sprowston Grange, Norwich
1906 *Hamond Major Philip, D.S.O., Morston, Holt, Norfolk
1923 Harbord Miss P., Mousehold House, Norwich
1928 Hardinge Lt.-Col. T. S. N., D.S.O., Flaxmoor, Caston, Attleboro'
1919 Harker Miss Sylvia, Blofield Hall, Norwich
1908 Harker William, Blofield Hall, Norwich
1923 Harmer Russell T., The Grange, Rackheath, Norwich
1881 *Harmer Sir Sidney, K.B.E., F.R.S., *V.P.*, The Old Manor House, Melbourn, near Royston, Herts.
1906 Harris Rev. G. H., Acock's Green Vicarage, Birmingham
1925 Hartcup Miss, Dial House, Cathedral Close, Norwich
1923 Hastings Lord, Melton Constable Park, Norfolk
1925 Hemingway P. H., Bureside, Wroxham
1928 Hendy E. W., Holt Anstiss, Porlock, Somerset
1926 Herbert E. G., Braken How, Sheringham
1925 Hewitt H. Dixon, F.I.C., 25, Croxton Road, Thetford
1925 Heywood R., Pentney House, Narborough, Norfolk
1923 Hibberd Rev. H., Burnham Thorpe Rectory, King's Lynn
1893 *Hill Alexander, M.D., F.R.S., Highfield Hall, Southampton
1919 Hinde Dr. E. B., 31, Mount Pleasant, Norwich
1891 Hinde F. C., *Hon. Librarian*, Oaklands House, Cringleford, Norwich

Elected.

1923 Hines E. S., 10, Parker Road, Norwich
1915 Hitchcock Arthur, Tamworth House, Tennyson Road, King's Lynn
1921 Hoare Miss Marjorie, 17, Camberley Road, Norwich
1919 Horsfall Charles, Stody Lodge, Melton Constable, Norfolk
1925 Hose Dr. C., F.R.G.S., "Redleaf," Riddlesdown Road, Purley, Surrey
1923 Hoskins Maj. Gen. Sir Reginald, Philip Stott College, Overstone Park, Northampton
1919 Howard H. J., *President*, 6, College Road, Norwich
1924 Howes Miss Alice, 26, Cathedral Close, Norwich
1926 Howlett J. K., The Beeches, East Dereham
1927 Hudson Lt.-Col. P., C.M.G., D.S.O., Martincross, Sheringham
1923 Hunter Miss E. M., Mattishall Hall, East Dereham
1923 Hunter H. M., Mattishall Hall, East Dereham
1899 Hurrell H., 25, Regent Street, Gt. Yarmouth
1915 Hutchinson Donald, M.D., 2, Gordon Road, Lowestoft

J

1921 Jarrold T. H C., Pine Banks, Thorpe St. Andrew
1891 Jarrold W. T. F., Beeston St. Andrew, Norwich
1927 Jessopp A. L., Lexham Hall, King's Lynn
1896 *Jodrell Sir Alfred, Bart., Bayfield Hall, Norfolk
1926 Jolly Ll. B., Aylmerton Hall, Norfolk
1923 Jolly T. L., Manor House, Worstead
1885 Jones Sir Lawrence, Bart., 39, Harrington Gardens, London, S.W., 7.
1926 Jourdain Rev. F. C. R., Laverstock, 13, Belle View Road, Southbourne, Bournemouth

K

1926 Keith E. C., Swanton Morley House, East Dereham
1927 Kendall O. D., Dept. of Geography, University of Bristol
1897 Kerrison Colonel E. R. A., C.M.G., D.L , Burgh Hall, Aylsham, Norfolk
1925 Kerrison Mrs., Burgh Hall, Aylsham, Norfolk
1912 Ketton-Cremer W. C., Felbrigg Hall, Norfolk
1926 Kimberly Mrs., M.Sc., "Constantia," Elm Grove Lane, Norwich
1904 Kinder Rev. E. H., Kirby Bedon Rectory, Norfolk
1898 Knight Edward, Keswick Old Hall, Norwich

L

1925 Labouchere P., The Lodge, Burnham Thorpe, King's Lynn
1926 Lane D. H., Framingham Pigot, Norwich
1918 Lascelles Miss Susan, Swanton Novers, Norfolk
1869 O.M. Laurence Rev. Canon J. A., Dilham Rectory, Norwich
1926 Leconfield Lady, Petworth House, Petworth, Sussex
1921 le Strange C., Hunstanton Hall
1909 Leicester The Right Hon. the Earl of, G.C.V.O., C.M.G., *V.P* Holkham
1899 Leney F., Castle Museum, Norwich
1927 Lister Dr. S. R., Terrington Lodge, King's Lynn

Elected.

1924 Little J. E., 19, The Avenue, Hitchin
1923 Livesay Surg. Cap. R.N., St. Andrew's Hospital, Thorpe, Norwich
1922 Livesay Mrs., St. Andrew's Hospital, Thorpe St. Andrew
1922 Lloyd Capt. L., Taverham Mill, Norwich
1925 Lloyd Mrs., Taverham Mill, Norwich
1899 Long S. H., M.D., F.Z.S., M.B.O.U., *Hon. Sec.*, 31, Surrey Street, Norwich
1907 Long Mrs. S. H., 31, Surrey Street, Norwich
1919 *Long Miss E. M., 31, Surrey Street, Norwich
1924 Long Miss M., 10, The Close, Norwich
1923 Long G. S. B., St. Giles Plain, Norwich
1928 Lotbinière Mrs. Joly de, Brandon Hall, Suffolk
1921 Lucas The Baroness, Horsey Hall, Great Yarmouth
1925 Luddington Miss, Wallington Hall, King's Lynn

M

1924 MacKenzie Miss G., The Cottage, Ingworth, Norwich
1923 Mackie, Mrs., The Red Cottage, Bergh Apton, Norwich
1923 *Macpherson A. Holte, 21, Campden Hill Square, Kensington, W.8
1905 Mann Sir Edward, Bart., Thelveton Hall, Norfolk
1906 Marriott F. W. P., 11, Queen Street, Norwich
1892 Marsham Major H. S., Rippon Hall, Marsham, Norfolk
1912 Mason A., Bank Plain, Norwich
1911 Master George, M.D., Bury St. Edmunds
1926 Matthews H. Whitlingham
1893 Mayfield A., F.L.S., Mendlesham, Stowmarket
1926 McCall C. Home, Walberswick, Suffolk
1922 McKenna Mrs. Reginald, 36, Smith Square, Westminster, S.W. 1.
1926 McLean Colin, Humbletoft, East Dereham
1926 Meade Miss P., Croxton, Thetford
1898 Meade-Waldo Edmund G. B., Stonewall Park, Edenbridge, Kent
1928 Mileham J., Aylsham, Norwich
1928 Mileham Mrs., Aylsham, Norwich
1877 Miller Henry, Bosmere House, Norwich Road, Ipswich
1923 Minns Mrs. E., Hammond's Wood, Frensham, Surrey
1923 Moppe Lewis E. van, Cliffside, Overstrand
1928 Morel Mrs., Burnley Hall, Martham, Norfolk
1924 Mortimer Ernest, The Red House, Wrentham, Suffolk
1922 Mountfield Miss M., Horsford Rectory, Norwich
1919 Moxey Llewellyn, Framingham Hall, Norwich
1923 Moxham M. C., Aldborough, Norwich
1920 *Mullens Major W. H., Westfield Place, Battle, Sussex
1921 *Murton Mrs., Cranbrook Lodge, Kent

N

1904 Napier A. J., *Hon Mem.*, Braes, St. Mawes, Cornwall
1926 Nash J. E., 37, Mulgrave Road, Dollis Hill, N.W. 10
1922 Nevill Rev. R. W., Old Catton Vicarage, Norwich
1926 Nevill Mrs. R. W. .. ..
1925 Neville Sir R. J. N., M.P., Sloley Hall, Norfolk
1911 Newman L. F., St. Catherine's College, Cambridge
1893 Newton E. T., F.R.S., *Hon. Mem.*, H.M. Geological Survey Office, 28, Jermyn Street, London
1889 Nicholson W. A., *Hon. Mem.*, 5, Mill Hill Road, Norwich
1915 Nightingale S. R., Scratby Hall, Great Yarmouth
1926 Norfolk and Norwich Library, Norwich
1919 Norgate Philip, Swanington, Norfolk
1915 Norwich Public Library
1927 Notcutt R. F., Woodbridge

Elected.

O

1927 O'Donnell O., Great Fransham, East Dereham
1921 Offord Miss Georgina, "The Larks," Water Lane, Costessey
1914 Oliver Prof. F. W., D.Sc., F.R.S., *Hon. Mem.*, *V.P.*, University College, London, W.C. 1
1924 Orgill Miss M. A., Garboldisham, Diss

P

1889 Page G. W., Walsingham, Norfolk
1919 Pain Percy, Dersingham, King's Lynn
1913 Paine Rev. N. W., Great Melton Rectory, Norfolk
1919 *Palmer Mrs. P. Hurry, "Red Roofs," North Drive, Great Yarmouth
1926 Pank A. H., Bedford Street, Norwich
1912 Parker H., 10, Aspland Road, Norwich
1925 Parker Miss Molly Hyde, Smeetham Hall, Sudbury, Suffolk
1921 Parker R. E., Marlingford, Norwich
1883 *Parkin Thomas, M.A., F.Z.S., High Wickham, Hastings
1873 Partridge Rev. W. H., M.A., "Breccles," Sandown, I. of W.
1923 Partridge F. H., St. Helier, Hunstanton
1889 Patterson Arthur H., *Hon. Mem.*, Ibis House, Lichfield Road, Gt. Yarmouth
1920 Patteson Mrs. F. E., Great Hautbois House, Norfolk
1901 *Paul J. J. Dawson, Eaton Grove, Norwich
1911 *Payler Donald, The Museum, Birmingham
1926 Payne T. P. H., Rede Rectory, Bury St. Edmund's
1923 Peed John, Aylsham
1928 Penrose F. G., M.D., "Woodbury," 9, Grove Road, East Cliff, Bournemouth
1926 Percy Lord William, Catfield Hall, Norwich
1903 Petre Col. B., Westwick Hall, Norfolk
1925 Petrie Mrs , The Dower House, Heydon, Norwich
1926 Phillippo G., 7, St. Philip's Road, Norwich
1925 Pilch R. G., 45, Grosvenor Road, Norwich
1923 Pope Dr. G. Stevens, Heigham Hall, Norwich
1880 Preston A. W., F.R.Met.Soc., Christ Church Lodge, Norwich
1919 Preston Sir E., Bart., Beeston Hall, Norwich
1900 Preston F., Thorpe Mansions, Norwich
1913 Purdy T. W., Woodgate, Aylsham
1925 Purnell Mrs. Ralph, 9, The Crescent, Norwich
1925 Purnell Ralph, 9, The Crescent, Norwich
1887 Pycraft W. P., A.L.S., F.Z.S., British Museum (Natural History), London, S.W.

R

1928 Raywood W., 13, Upper King Street, Norwich
1925 Reeves Hugh, Honingham Hall, Norwich
1924 Richmond H. W., F.R.S., King's College, Cambridge
1925 Ringrose B., Farley, Harbridge Green, Ringwood, Hants.
1924 Rippingall Neale F., Crabbe, Weighton S.O., Norfolk
1911 Rising A. P., The Manor House, Ormesby, Great Yarmouth
1908 Riviere B. B., F.R.C.S., F.Z.S., M.B.O.U., Hill House, Saxlingham, Norwich
1869 O.M. Robinson H. S., Eaton, Norwich
1908 Rogers Commander F. S., R.N., Ingham New Hall, Norwich
1909 Rogers Rev. Henry, Coltishall Hall, Norwich
1884 *Rosebery The Right Hon. the Earl of, K.G., 38, Berkeley Square, W. 1.
1908 *Rothermere Rt. Hon. Lord, Hemsted Park, Cranbrook, Kent
1897 *Rothschild Rt. Hon. Lord, F.Z.S., Tring, Herts.
1922 Rounce G. H., The Pines, Park Road, Cromer

Elected

1918 Rudd A. J., F.Z.S., Queen Street, Norwich
1902 *Ruggles-Brice Mrs. R., Dar-es-Saalam, East Africa
1906 Rumbelow P. E., 27, Rodney Road, Great Yarmouth
1919 Russwurm Mrs., Scarning Grange, E. Dereham
1901 Rye Walter, 66, Clarendon Road, Norwich

S

1925 Sewell P. E., Dudwick House, Buxton, Norwich
1925 Sexton K. F., 156, Newmarket Road, Norwich
1922 Shepheard Dr. Samuel, Aylsham
1924 Shepherd Miss A. M., Convalescent Home, Lowestoft
1926 Shields, A. A., "Greenholm," St. Clement's Hill, Norwich
1921 Silcock Chas., 56, Southwark Bridge Road, London, S.E.1.
1919 Simpson F. T., Sheringham, Norfolk
1926 Slater, B. M., "Bassenhill," Corton, Lowestoft
1919 Smith Col. H. F., Didlington Hall, Norfolk
1915 Smith Mrs., Ellingham Hall, Bungay
1891 Smith W. R., Harleston, Norfolk
1909 Snow T., The Craig, Windermere
1917 Sowels Miss, Thetford
1922 Spalding G., 9, St. Stephen's Street, Norwich
1911 Spurrell J. T., Manor House, Newton St. Faiths, Norwich
1923 Spurrell Miss M., Manor House, Newton St. Faith's, Norwich
1923 Spurrell Miss P., Manor House, Newton St. Faith's, Norwich
1925 Steers J. A., St. Catharine's College, Cambridge
1921 Stimpson Edward, Sall Moor Hall, Reepham, Norfolk
1927 Stourton Hon. J., Cawston Manor, Norwich
1922 Sumpter Dr. B. G., Brancaster Staithe, King's Lynn
1896 Sutton W. Lincolne, F.I.C., Eaton, Norwich

T

1921 Taylor Dr. Mark R., 49, Mount Pleasant, Norwich
1878 Taylor Shephard T., M.B., The Mount, Edgefield, Melton Constable
1921 Thain D., West Somerton, Norfolk
1886 Thouless H. J., "Southernhay," Wroxham
1924 Thursby-Pelham Miss D., Fisheries Laboratory, Lowestoft
1896 Tillett Wilfrid S., 2, Claremont Road, Norwich
1920 Todd Lt.-Col. Eardley, Mundham House, Brooke
1902 Todd R. A., B.Sc., The Retreat, Elburton, Plymouth
1923 Tomes Lady, Mannington Hall, Norfolk
1910 Tracy N. 3 King Street, King's Lynn
1925 Tucker B. W., 3, Park Crescent, Oxford
1906 Turner Miss E. L., F.L.S., H.M.B.O.U., *Hon. Mem.*, 13, Storey's Way Cambridge
1927 Turner Edgar, "Kuruman," Walberswick

U

1923 Upcher Rev. E. C. S., Great Dunham Rectory, Norfolk
1921 Upcher H. E. S., The Gables, Upper Sheringham

V

1917 Vincent James, Hickling, Norfolk

W

1921 Wallis Rev. M. C., The Vicarage, St. Faiths
1923 Walter Mrs. Cyril, Old House, Drayton, Norwich
1921 Walton Miss, 17, Camberley Road, Norwich
1923 Waterfield Miss, Attlebridge, Norfolk
1923 Waterfield Miss Penelope, Attlebridge, Norfolk

Elected

1928 Watson J. B., c/o Barclays Bank Ltd., Surbiton, Surrey
1926 Wemys Major, "Bryn coed," Wroxham
1927 Wemys Mrs. ,, ,,
1923 Wenn Miss, Ingham, Norfolk
1883 *Whitaker Joseph, F.Z.S., Rainworth Lodge, Mansfield
1928 Whitwell Miss, 1, Cambridge Street, Norwich
1901 Wild Edward, The Hawthorns, Eaton, Norwich
1922 Willett W. L., Paddock Wood, Kent
1913 Williams Miss Margaret, 28, The Close, Norwich
1909 Witherby H. F., M.B.E., F.Z.S., 326, High Holborn, W.C.
1924 Wolsey Noel G., 15, King Street, Great Yarmouth
1928 Wood M. S., M.D., Woodland House, Windermere
1923 Woolsey G. E. W., Old Catton, Norwich
1907 Wormald Hugh, M.B.O.U., Heathfield, East Dereham
1922 Wortley Francis, "Congham," Sheringham
1924 Wright B. D. Z., Hoveton St. John, Norwich
1920 Wyllys Hugh, "Shrublands," Southtown, Great Yarmouth

Y

1923 Young The Right Honble. Sir E. Hilton, D.S.O., P.C., M.P., 174, Buckingham Palace Road, S.W.
1915 Yarmouth Free Library, The, Great Yarmouth

TOTAL

Honorary Members	...	8
Life ,,	...	33
Ordinary ,,	...	378
		419

JUNIOR BRANCH

Barclay Miss H., Tittleshall Rectory, King's Lynn
Barclay Miss P., The Warren, Cromer
Barclay Peter, The Warren, Cromer
Barclay Thomas, The Warren, Cromer
Barrett Reginald, 12, Beatrice Road, Thorpe Hamlet
Barry Miss E., Great Witchingham Hall, Norwich
Barry Miss N., Great Witchingham Hall, Norwich
Chamberlain Miss J., Witton Rectory, Norwich
Citters Miss W. van, Wroxham, Norwich
Cole Miss R., Sprowston, Norwich
Cole A. L. F., Sprowston, Norwich
Ferrier Miss J. M., Hemsby Hall, Great Yarmouth
Hyslop Gordon, Drayton, Norwich
Lascelles Miss S., Swanton Novers, Melton Constable
Long Miss E., 31, Surrey Street, Norwich
Morrison Miss E., Barmer Hall, King's Lynn
Morse Miss R., Earlham Lodge, Norwich
Parker Miss P., Marlingford, Norwich
Upcher Miss, Dunham Rectory, King's Lynn
Upcher Miss R., Dunham Rectory, King's Lynn
Walter Miss E., Drayton Old House, Norwich
Waterfield Miss B., *Hon. Sec.*, Attlebridge, Norwich
Waterfield Miss Penelope, Attlebridge, Norwich
Waterfield, Miss Philida, Attlebridge, Norwich
Wathen R., Bolwick, Marsham, Norwich
Wathen M., Bolwick, Marsham, Norwich
Winch Miss D., Swanington Court, Norwich

The Treasurer in Account with the Norfolk and Norwich Naturalists' Society, Year Ending April, 1928

I. GENERAL ACCOUNT

Dr.

1927–28	£	s.	d.
To Balance on Current Account 13 15 7			
,, ,, Deposit ,, ... 119 6 2			
	133	1	9
,, Subscriptions	189	10	0
,, Sale of "Transactions" and "Flora of Norfolk"	1	2	0
,, Interest on War Stock	5	5	4
,, ,, Deposit a/c	2	19	1
,, Publication Fund	24	9	6
,, Donation, Dr. Penrose	2	2	0
,, From W. B. P. F.	10	0	0
	£368	9	8

Cr.

	£	s	d.
By "Transactions," vol. xii., part iii.	120	4	0
,, Norfolk & Norwich Library, Rent of Room	6	6	0
,, Postages	8	12	9
,, Printing	4	0	6
,, Book-binding	6	0	9
,, Expenses of Meetings	11	14	0
,, Fire Insurance	0	13	6
,, Illustrations and Reprints, W. B. P. F. Report	8	5	0
,, Cheque books ... ... —	0	7	0
,, Transferred to Life Membership Fund	100	0	0
,, Balance on Current a c	80	0	11
,, ,, Deposit a c	22	5	3
	£368	9	8

Examined and found Correct,
W. A. NICHOLSON,
May 3, 1928

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II. SPECIAL PUBLICATION FUND

1927-28.	£	s.	d.		£	s.	d.
To Donations—				Transferred to General Account	24	9	6
R. J. Colman	10	0	0				
S. H. Long	5	0	0				
E. Wild	1	0	0				
Dr. Sumpter	0	11	0				
Sums of 10s. and under	7	18	6				
	£24	9	6		£24	9	6

III. LIFE MEMBERSHIP FUND

1927-28.	£	s.	d.		£	s.	d.
To Balance in Savings Bank	62	14	2	To Interest on War Loan, transferred to General Account ...	5	5	4
,, One Life Member	8	0	0	,, Purchase of £50 5 per cent. War Stock, 1929-47	50	18	1
,, Interest on Bank Account	1	12	7	,, ,, £116 1s. 10d., 4 per cent. Consolidated Stock ...	100	0	0
,, Interest on War Loan	5	5	4	,, Balance in Savings Bank	21	8	8
,, Transferred from Deposit Account	100	0	0				
	£177	12	1		£177	12	1

List of Investments and Assets

	£	s.	d.
£155 6s. 10d. 5 per cent. War Stock 1929-47, at cost	150	18	1
64 War Savings Certificates dated 24.1.19	64	0	0
31 War Savings Certificates, dated 17.7.23. at cost	24	16	0
£116 1s. 10d., 4 per cent. Consolidated Stock, at cost	100	0	0
Balance in Savings Bank	21	8	8
	£361	2	9

ADDRESS

Read by the President, H. J. Howard, F.L.S., F.R.M.S., *to the members of the Norfolk and Norwich Naturalists' Society, at their Fifty-Ninth Annual Meeting, held at the Castle Museum on April 23rd*, 1928.

Ladies and Gentlemen,

Just a year ago this Society conferred upon me the honour of being its President, an honour which as a Norfolk naturalist I deeply appreciate as I look back upon the long list of names of those distinguished in some branch of Natural Science, who have held this office before me. My year of office terminates to-day, and as is customary, I will briefly review the work of the year and the present position of our Society.

It was impossible to arrange any excursions last year, as an excursion secretary could not be found; however, when one looks back upon the weather record this was perhaps a blessing in disguise. I have always felt that it was a great pity that organised field work cannot be carried out (between the periods of indoor meetings), to a larger extent than has been customary, though doubtless there are difficulties of geography and transport.

During the year 1927-1928, seventeen new members have been elected. We have lost by death Sir Eustace Gurney who has been a member for thirty years, and Capt. S. V. Green, who has been a member of the Society for seven years. Sir Eustace was one of our Vice-Presidents and was also President of the Society in 1905; we hope to publish an obituary notice in the next Part of the Transactions.

Six ordinary meetings have been held during the session and have been well attended. The following have favoured us with papers.

Sept.—No paper read but various exhibits of general interest were displayed.

Oct.—Dr. Penrose, "Camouflage," with autochrome photographs of birds.

Nov.—Miss Thursby-Pelham, a lantern lecture on the "Migration of Fish in the North Sea."

Jan.—The President, lantern lecture, "Shells and Their Inhabitants."

Feb.—Mr. Donald Payler, lantern lecture, "The Management of Aquaria."

Mar.—Mr. Stuart Baker, lantern lecture, "The Uses and Abuses of Egg Collecting."

Before concluding these preliminary remarks I should like to mention our indebtedness to the Castle Museum Committee for the privilege of using the Museum for our meetings, and to thank Mr. Leney and his staff for their help in connection with them. When we realise that four of our lantern lectures have been held in this room, I think we should appreciate the amount of trouble that is taken in providing a lantern and such an excellent operator on each occasion.

One of the most difficult tasks that falls to the lot of a President of this Society must be that of choosing the subject of his Presidential Address. When one remembers that the Society has been in existence for nearly sixty years and that each President has followed the precept of his predecessors by producing an address at the end of the year upon some particular branch of Natural Science, it is no easy matter to select a subject which has not been fully dealt with before. After spending a considerable amount of thought upon the matter, I finally decided to follow the examples of many of our past Presidents and deal with the particular group which has been the special subject of my study for the past fourteen years.

The subject of my address to you this afternoon will be :—

THE MYCETOZOA—THEIR LIFE HISTORY AND THE HISTORY OF THEIR STUDY, TOGETHER WITH NOTES ON THEIR OCCURRENCE IN NORFOLK

My reasons for selecting this group are, firstly because I have made it the subject of special research over a fairly long period ; secondly, they are a very interesting and fascinating group, and comparatively little known ; thirdly, records of Mycetozoa found in the county of Norfolk have appeared at somewhat wide intervals in the Transactions of the Society,

but no full list has ever been published. Finally, I have a hope that some members may become interested in the group and send me material from parts of the county which I have not been able to touch.

THE MYCETOZOA.—The word itself means "Fungus-animals" a somewhat paradoxical name. Are they Fungi? No. Shall we at once place them in the animal kingdom? That question is difficult to answer to everbody's satisfaction, and it will be best to regard them as upon the border-line between plants and animals. They are at any rate living organisms with a unique life history and diversity of form, besides being objects of great beauty.

HISTORY.—The Mycetozoa are organisms which have been bandied about, being claimed by both botanists and zoologists alike; we find short accounts of them in the best textbooks upon Botany as well as in standard works upon Zoology. At the present time the extensive collection at the British Museum of Natural History is housed in the herbarium devoted to the Cryptogams or flowerless plants. You will therefore be quite prepared to hear that from time to time they have been known by various names.

Owing to the resemblance of the sporangia or fruiting bodies to small puff-balls, the earlier naturalists regarded the Mycetozoa as belonging to the Fungi. The first undoubted reference to the group was made by Panckow who figured and described in 1654 a species of very common occurrence now called *Lycogala epidendrum*.

Micheli, the Italian botanist, in 1729 published a great botanical work. He threw fresh light on the life history of Fungi and described and illustrated four genera of Mycetozoa.

During the succeeding hundred years systematic work proceeded apace and the group was ably studied by Charles Persoon who named eighty species of Mycetozoa.

Elias Fries (1794-1878), the great Swedish botanist, and contemporary of our noted mycologist the Rev. Miles Berkeley, made careful observations of the group in the field, and, realizing the importance of the feeding or plasmodial phase, placed the Mycetozoa in a sub-order to themselves under the name of Myxogastres; he still regarded them as belonging to the Gasteromycetous Fungi.

Wallroth in 1833, gave them the name of Myxomycetes (German Schleimpilze or English "slime fungi.")

It is to De Bary, the German botanist, that we owe the name Mycetozoa or "Fungus-animals." He was the first to cultivate the spores, and found that, instead of producing slender threads as do the spores of Fungi, each spore gave birth to a naked mass of protoplasm, the swarm-cell. He saw the swarm-cells swim with a peculiar dancing motion, divide, withdraw the organ of locomotion called the flagellum, and then creep about as amoebulæ. Although he did not actually note the union of the amoebulæ, he inferred that the young plasmodia seen in his cultures arose from their fusion. He gave a lucid account of the rhythmic circulation in the interior of the plasmodium, and of the growth and structure of the sporangia; he was really the first to introduce the modern view of this remarkable group.

Cienkowski, De Bary's pupil, in 1863 confirmed what his master suspected and saw the union of the amoebulæ; it was he who gave the name "plasmodium" to the naked mass of protoplasm so produced. He also noticed the ingestion of solid food by the plasmodium and thus showed the animal affinities of the group.

Under the heading Mycetozoa, De Bary still retained the name Myxomycetes for the section so named by Wallroth, but also attached a small group of simpler organisms, the Acrasieæ, which are not now regarded as coming under the general name of Mycetozoa. De Bary attracted several pupils to the study of the Mycetozoa and among them may be mentioned Dr. Joseph Rostafinski whose splendid and well illustrated "Sluzowce Monografia" (Monograph of the Mycetozoa pub. 1875), alas in Polish, became the standard work upon the subject. M. C. Cooke, the well-known Norfolk mycologist, made the main features of the monograph available for English readers by giving a translation of the keys to the genera and species.

Since the publication of Rostafinski's monumental work, much literature has appeared upon the group and I cannot refrain from mentioning the great debt of gratitude which students of the Mycetozoa owe to Arthur Lister, whose death in 1908 robbed them of one who was always ready to assist

and encourage workers from all parts of the world. That work, however, has been most ably carried on by his daughter, Miss Gulielma Lister, who has piloted her father's most useful Monograph of the Mycetozoa through two editions, the third edition published by the British Museum Trustees in 1925 being the standard work upon the subject and indispensable to the student of the group. I wish to express my thanks to Miss Lister for her many kindnesses, her encouragement and valuable help in verifying the records which have been made for this county.

Life History.—I shall now proceed to give you a brief account of the life history of this unique and interesting group of organisms. The life cycle of a typical member passes through three, and under certain conditions five, distinct phases. It will be convenient if we first briefly touch upon the final or reproductive stage and then return to it in more detail later on.

In a ramble through a shady damp wood during the summer months, especially in warm, wet weather, one who knows where to look would sooner or later discover a piece of rotting wood or an old tree stump on the surface of which would be some greyish bead-like bodies supported on grey or yellowish wrinkled stalks. They would be very small, not more than from one to one and a half millimetres in height ; they are the fruiting bodies or sporangia of a very common species called *Physarum nutans*. If a sporangium be examined with a pocket lens or, better still, with the low power of a microscope, it will be seen that the sub-globose head is covered with a delicate membranous sporangium wall, white from deposits of carbonate of lime ; this is easily ruptured, disclosing a mass of brownish-violet dust-like spores. These are the reproductive bodies and from these we may now trace out the whole life cycle.

Spore and Swarm-Cell.—In all but one genus of Mycetozoa the spores are developed inside the spore-case or sporangium, giving us the large section of the Endosporeæ ; the term Exosporeæ is used for the single genus in which the stalked spores are borne on the surface of a spore-bearing body called the sporophore.

If we examine the moistened spores of our specimen under a higher magnification it will be found that they are spherical, violet-brown in colour, and from eight to ten thousandths of a

millimetre in diameter; so that a magnification of from 600 to 1,000 diameters is necessary to examine them properly. The spore-wall is seen to be nearly smooth or covered with minute spines. It might here be mentioned that in all normal developments, the size, colour, and surface markings of the spores of each species are so remarkably constant that they form important diagnostic characters. Spores kept in a dry state maintain their vitality for several years. If placed in a drop of water the spore-wall will sooner or later rupture from the swelling of its contents, and a tiny nucleated mass of protoplasm escapes. It gradually frees itself from the spore-case as an almost transparent globule which after a brief period of quiescence begins to creep about with amoeboid movements. This globule is the swarm-cell or swarm-spore and shortly after emergence it develops at one end a hair-like process, the flagellum, by means of which it is propelled through the water with a peculiar dancing, rolling motion; the flagellum may also possess a tactile function. It is a most fascinating sight to watch the whole process of the birth of a swarm-cell in a hanging-drop culture in a moist chamber. The flagellate swarm-cell is pyriform and contains a nucleus at the more pointed or flagellum end, and also a contractile vacuole, and often vacuoles of a non-contractile character distributed among the granular protoplasm. How does this motile swarm-cell feed? Here we have a very interesting question, the answer to which partly supplies the evidence as to why the Mycetozoa are regarded as belonging to the Rhizopod group of the Protozoa or simplest forms of animal life. By means of projections of the protoplasm called pseudopodia, the swarm cells are able to capture and digest solid food in the form of bacteria, which abound in the moist substratum. These are covered with an extension of the body substance and ingested in the vacuoles. Should the food supply become insufficient, a resting period intervenes to tide over the time of scarcity; the flagellum is withdrawn and the cell assumes a globular encysted form and can then retain vitality even if quite dry. Upon re-wetting, the membranous cyst-wall is ruptured and the swarm-cell resumes its activity. Swarm-cells multiply by bipartition and the process begins a few hours after they have left the spore-case. The

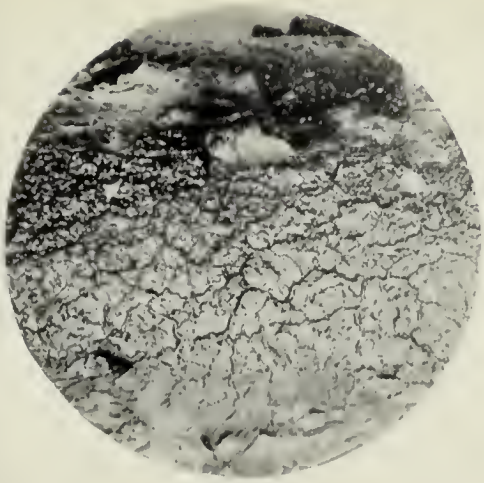

FIG. 1

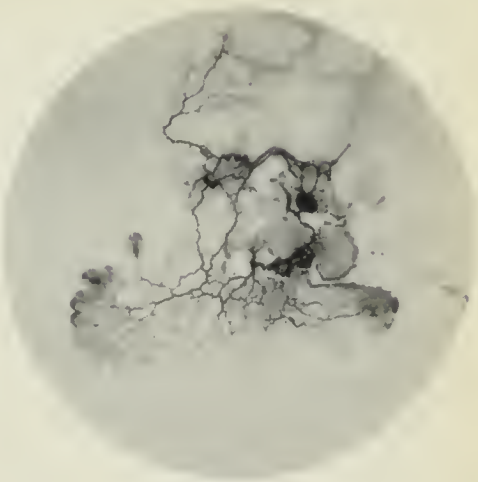

FIG. 2

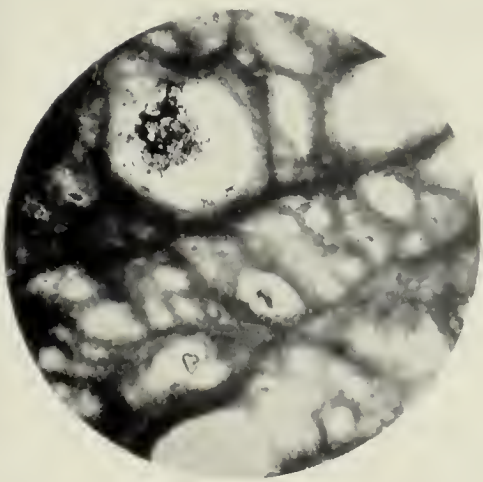

FIG. 3

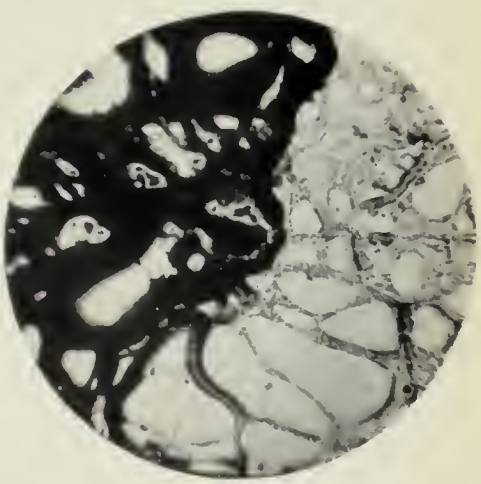

FIG. 4

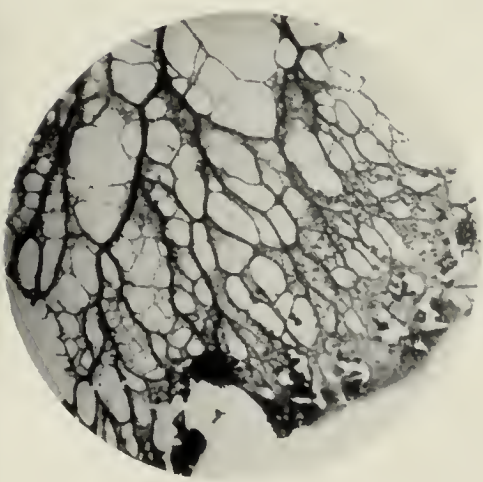

FIG. 5

FIG. 6

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nucleus divides by karyokinesis and each daughter nucleus is a replica of the parent from which it has sprung. We now pass on to another definite stage in the life cycle.

The Plasmodium.—After repeated divisions the swarm-cells withdraw the flagellum and creep about as amoebulæ; the process of division still taking place. They then collect in groups and begin to unite in pairs as gametes to form zygotes, their nuclei also uniting. The fact that the fusion appears to be selective shows that we have here a primitive type of sexual union. These zygotes commence to feed and are called plasmodia; they rapidly increase in size by the ingestion of unpaired amoebulæ and fuse rapidly when they come into contact with each other, the nuclei however remaining separate. We have thus a mass of naked protoplasm containing a large number of nuclei, and this plasmodial stage is the dominant feeding phase of the Mycetozoa. The plasmodium, which varies in size and may be several inches across, possesses the remarkable power of creeping about in various directions; it should be mentioned that the plasmodia of some species live in the interior of decaying wood and are only noticeable at the fruiting stage. The nature of the food varies in different species; the majority feed on dead vegetable matter, while some devour living fungi. A convenient plasmodium for study is that of *Badhamia utricularis*; it is usually found in large chrome-yellow masses feeding upon leathery fungi such as *Stereum hirsutum*. Under the microscope the fan-like veins of the protoplasm may be seen to dissolve the fungus hyphæ as they pass over them. If a small piece of this plasmodium be allowed to creep on to a glass cover-slip supported over a moist chamber it is easy to watch it microscopically. The interior is seen to consist of granular protoplasm containing a large number of nuclei and vacuoles; this is invested with a more hyaline portion devoid of granules and apparently of a firmer consistency. In addition to the mass moving slowly forward, we can see by transmitted light a wonderful rhythmic flow taking place in the network of veins. This flow of the granular and more fluid part of the protoplasm is alternating; there is, as it were, an ebb and flow, and I know of no more fascinating sight than the current rushing like a torrent rapidly through the veins, gradually slowing down and coming

to rest, reversing, and then slowly speeding up in the opposite direction. This remarkable streaming movement occupies from a minute and a half to two minutes in one direction but is always of a somewhat longer duration in the direction, in which the plasmodium is creeping The cause of this movement has so far not been determined. After the plasmodium has passed over an area its track is plainly marked by a double line of discharged refuse matter, and often a kind of map is left by the creeping protoplasm. The colour of the plasmodium varies in different species ; it is usually white, pink, or yellow ; but in some species it may be purple, lead-coloured, and even a sap green.

It will be interesting to note that while plasmodia of the same species will unite, union has never been seen to take place between those of different species.

The Sclerotium.—Another remarkable feature of the plasmodium is seen in its ability to tide over adverse conditions such as drought and great cold. If a piece of *Stereum* covered with the plasmodium of *Badhamia utricularis* be allowed to dry slowly the streaming movement gradually ceases and the protoplasm divides into a number of cells, forming in time a mass of dry horny nature known as a sclerotium. It can remain in this state of suspended vitality for a considerable period, but revives and resumes its streaming movement on being placed in water. The plasmodium of the species mentioned has been revived after being dry for three years and has ultimately passed into the fruiting stage. Here then is an interesting biological phenomenon ; a mass of slime-like material containing thousands of nuclei, ingesting solid food and excreting that which is of no use to the organism ; possessing the power of fusing with the protoplasm of the same species but avoiding that of others ; endowed with a creeping movement and having an alternating rhythmic ebb and flow within itself ; possessing the capacity of entering into a state of suspended vitality under adverse conditions, and finally at the end of its active period able to produce reproductive bodies, the spores enclosed in sporangia. It is this final stage that we must now consider.

The Sporangium.—Usually when food supply is abundant the plasmodium continues to feed and grow, but when nourish-

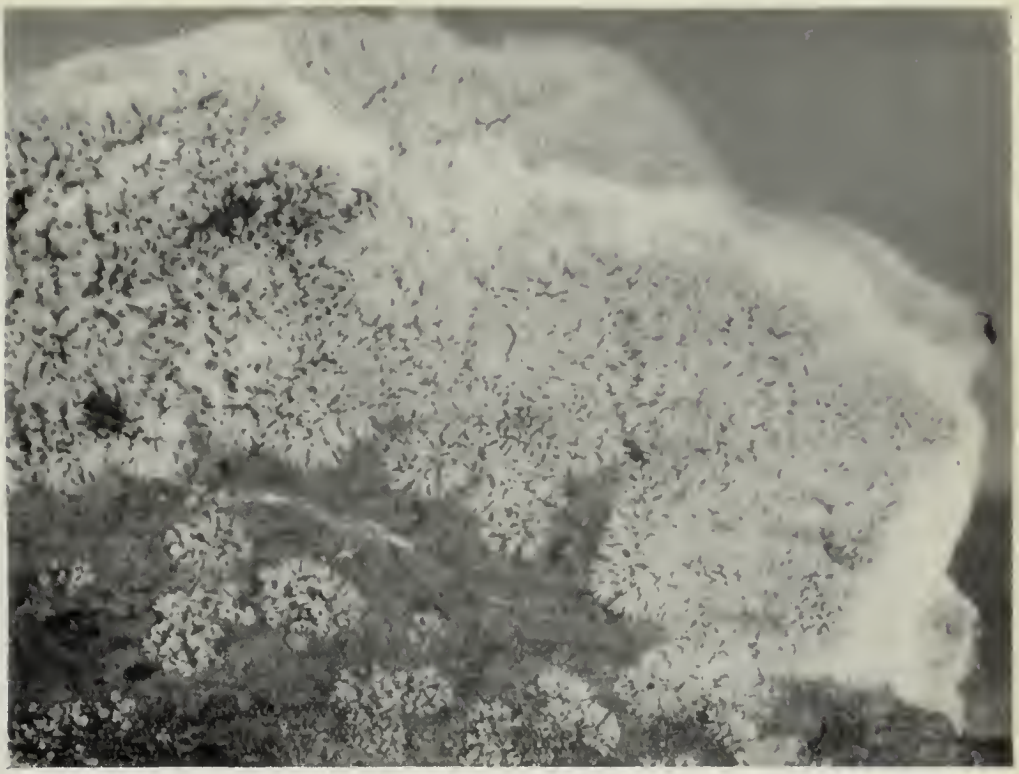

Fig. 1.

Fig 2.

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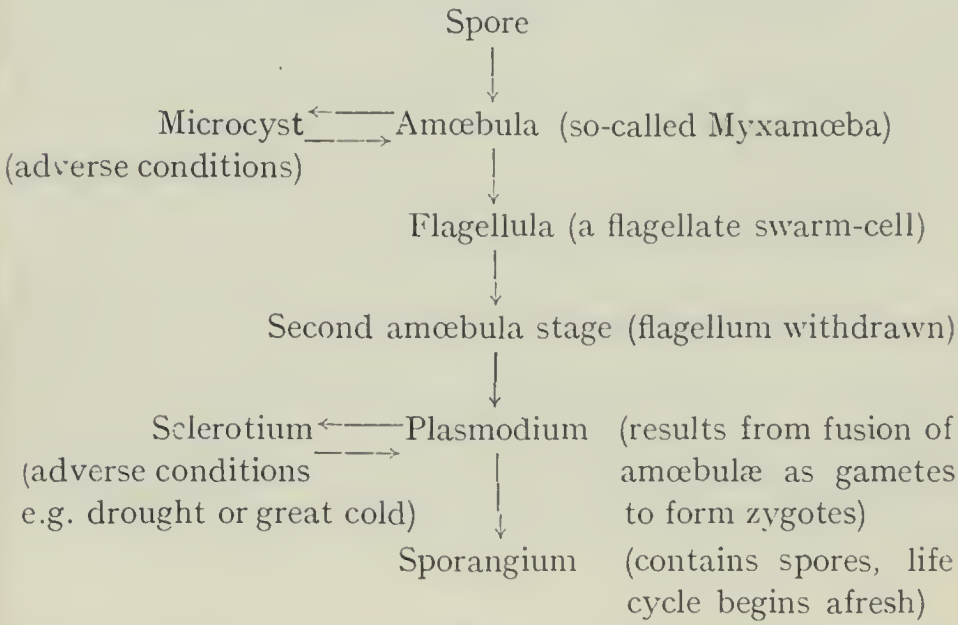
ment is no longer available it prepares to pass into the fruiting stage, and often leaves moist surroundings for a drier situation better adapted for the dispersal of the spores.

LIFE HISTORY OF A TYPICAL MYCETOZOON



Let us return to our *Badhamia*. The veins of the chrome yellow slime-like mass, now perhaps several inches across, are seen to contract and soon rise up into knobs scattered over its surface. These are the young sporangia which gradually assume an ovoid shape. A sporangium wall is secreted, and the part nearer the substratum forms a tube through which the plasmodium, having excreted its refuse matter, continues to pass, until we have suspended from the log or fallen tree trunk what look like bunches of minute yellow grapes hanging by long, frail, straw-coloured stalks. Within the sporangium wall the formation of spores is proceeding apace; this is preceded by the mitotic division of the nuclei, a process by which each daughter nucleus becomes the nucleus of a spore. It is interesting to notice that Dr. Jahn has shown that in the final division the number of chromosomes is halved, in other words it is a reduction division; thus the nuclei of the spores and their resulting swarm-cells are in the haploid condition; the diploid or normal number of chromosomes being restored by the fusion of the amœbulæ to form zygotes. In most Mycetozoa the division of the nuclei within

the sporangium is accompanied by cleavage of the protoplasm into masses which become subdivided until spheres of two spores capacity are produced each containing a single nucleus. Finally as the daughter nuclei separate, a constriction appears in the protoplasm and two spores are produced. By making a series of smears from the developing sporangia and staining them, the whole process of spore formation may be watched under the highest powers of the microscope and it is one of the most fascinating biological processes that I have ever seen.

Let us return to our sporangia ; the grape-like masses have gradually deepened in colour and have become ashen grey or an iridescent violet hue veined with white ; they are filled with thousands of violet-brown spores. We must not imagine that these spores are crowded into the sporangium in any haphazard fashion. Inside the sporangium wall is a network of flat lime-charged tubules with broader expansions called the capillitium. This structure showing much variety of form is of great importance in the determination of different genera and species. In species of *Comatricha* and *Stemonitis* the capillitium takes the form of a tree-like growth springing from a central stalked pillar called the columella ; the bases of the stalks are often connected by a membrane secreted by the remains of the plasmodium and this membrane is termed the hypothallus. The purpose of the varied capillitium appears to be in many cases to assist in dispersal of the spores by air currents ; its presence in almost all the Mycetozoa suggests that economically it is of great use to the species. Rain-water also washes the spores away. I have never seen it definitely stated that spores are dispersed otherwise than by the above means, but in certain cases I have found small beetles and aphides associated with particular species and it may be possible that they play an accidental part in spore distribution.

The sporangia of the Mycetozoa are objects of extraordinary beauty and it is interesting to learn that if carefully dried and stored away from insects and damp they retain their beauty permanently. They display a great variety of form and colour, the most typical shape being that of a somewhat spherical head mounted upon a slender stalk ; white, grey, yellow, brown, purple, black and crimson are colours to be found in British species. In the genera *Lamproderma*, *Diachea*

Fig. 1.

Fig. 2.

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and *Margarita* the sporangium walls are iridescent. Some species are stalkless or sessile; some form bolster-shaped sporangia called plasmodiocarps; and in others the individual sporangia are fused together to form a cushion-like structure known as an æthalium. I have met with æthalia of *Reticularia Lycoperdon* and *Fuligo septica* several inches across. The species of the genus *Arcyria* are very beautiful objects; as the sporangium wall bursts the elastic threads of the capillitium expand considerably, giving in *Arcyria nutans* a bunch of yellow structures not unlike lambs' tails; another species of *Arcyria* has a capillitium forming a sponge-like network of crimson threads; the capillitium of *Arcyria incarnata* is flesh-coloured; in another species it is copper-coloured, in one it is almost white, while the unique *Arcyria glauca*, found only in Japan, has sporangia which when fully expanded are pale green.

The genus *Trichia* deserves mention because of the interesting manner in which the spores are dispersed by hygroscopic changes of the atmosphere. Instead of the dense tangle of threads peculiar to the *Arcyrias*, the capillitium consists of free threads called elaters; these are marked with spirally twisted bands and under the action of moisture turn and twist about, flinging the spores into the air; one can easily watch this under the microscope if one gently breathes upon a burst sporangium.

The sporangium of *Cribraria* is a cup-like structure passing above into a delicate network forming a skeleton roof. Sporangia of *Craterium* are in the form of perfect cups fitted with a lid, while *Leocarpus* is often found covering the stems of grasses and bracken with glossy, plum-shaped sporangia of the shining brown colour of a ripe horse-chestnut.

Distribution.—The subject of distribution is a very interesting one. Mycetozoa are remarkably cosmopolitan, being found all over the world where the presence of decaying vegetation and sufficient moisture permit of their development. Many species hardly vary and are found in various climes. A few are confined to higher altitudes and regularly occur in spring near the melting snow in alpine regions; some are found in temperate regions while others occur in the damp tropical jungles of Ceylon, Java, or Brazil. But it is impossible to say

with certainty that a species may not occur in some unexpected locality. In one small wood near Norwich I found in 1916, 1917, 1919, and 1922, an abundance of a species, *Physarum carneum* G. Lister and Sturgis, which had only been recorded from the Cheyenne Mountain, Colorado Springs, with the exception of a small gathering from Portugal; as it occurs on dead leaves, bramble and bracken stems in dense bramble clumps it may possibly have been overlooked. Another rare species *Physarum gyrosum* Rost. occurred in cucumber houses in 1922 and 1928 in Norfolk, whilst a gathering was recently made in the Stratton Strawless woods of a varietal form which has only been previously met with in the Jura Mountains of Switzerland.

Habitats.—Mycetozoa occur in various habitats,but by far the greatest number of species feed within dead wood; their sporangia appear on fallen tree trunks which have become rotten, on old stumps, fallen branches and twigs and on old sawdust heaps. Heaps of decaying leaves, old straw, such as the remains of a previous year's stack or straw manure; turf, and dead herbaceous stems in alpine regions are all good hunting grounds. A few species are arboreal, being found some distance up the trunks of living trees among moss and lichens; I once remember seeing several silvery-white æthalia of *Reticularia Lycoperdon* four or five feet up the trunks of living lime trees in one of our city churchyards, and on two occasions I have found a species of *Stemonitis* maturing at the top of recently painted gateposts amid surroundings where one would never expect to see Mycetozoa. One habitat which has probably been overlooked because of its unforbidding aspect is beneath clumps of bramble bushes where fallen leaves and decayed bramble stems protected by a canopy of new leaves and branches form a favourable haunt for several species of Mycetozoa. One has to wear stout hedger's gloves and one's oldest clothes, use a rubber mat to kneel on and literally burrow into the dense thicket; such habitats have yielded me several rare species including one new to Britain.

According to the latest edition of the British Museum Monograph upon the Mycetozoa about three hundred species are at present known to science and 195 of these have been recorded from Great Britain and Ireland.

In conclusion it might be asked "What is the economic value of the study of the Mycetozoa?" As far as we know, those which come under the heading of typical Mycetozoa play little or no part in aiding or hindering mankind, and as Professor Keeble points out in his admirable little book on "Plant Animals," one may be apt to be criticised for expending so much time and labour on such insignificant organisms when so much remains to be discovered in connection with higher animals and even man himself. I will quote Professor Keeble in reply. In the first place, the most important biological discoveries have resulted from researches into the life histories of the lower organisms; we have only to think what modern surgery owes to researches on Bacteria or what Protozoology has achieved in diseases like sleeping sickness, malaria, and yellow fever. Secondly the increasing complexity of the higher animal organism makes it more difficult for us to use the results of observations upon it. The higher the organism in the animal scale, the more it has covered up the tracks along which the species to which it belongs has travelled, and the study of lower types may lead to results in the direction of helping forward the study of heredity, instinctive behaviour, habit, and evolutionary principles. Thirdly do the higher animals differ fundamentally from more lowly forms of life? That has yet to be proved; but differences are more those of degree, and in dealing for instance with plasmodium, which is practically naked protoplasm, it may be that some discovery may be made which will help forward our knowledge of organisms much higher in the biological scale than the Mycetozoa which I have mentioned this afternoon.

EXPLANATION OF THE PLATES

(From photographs by the author.)

PLATE XXXII

Fig. 1. Plasmodium of *Badhamia utricularis* Berk. creeping in veins over a dead branch (about $\frac{2}{3}$ nat. size).

Fig. 2. Living plasmodium of *Badhamia capsulifera* Berk. creeping over moistened sheet of glass and showing veins and expanded fans (about half nat. size).

Fig. 3. Photomicrograph of living plasmodium of *Badhamia capsulifera* Berk. (magnified 35 times). The darker portion of the veins is the moving, more fluid part of the protoplasm. The granular protoplasm was actively streaming when the photograph was taken.

Fig. 4. Photomicrograph of living plasmodium of *Badhamia capsulifera* Berk (magnified 35 times) showing double line of discharged refuse matter left by the retreating plasmodium which appears darker.

Fig. 5. Photomicrograph of stained preparation of *Badhamia utricularis* Berk. (magnified ten times).

Fit. 6. Sporangium of *Dictydium cancellatum* Macbr. after dispersal of spores showing ribs of sporangium wall. (magnified 30 times.)

PLATE XXXIII

Fig. 1. *Ceratiomyxa fruticulosa* Macbr. showing freshly-formed sporophores shortly after plasmodium had emerged from surface of a decayed pine log (nearly twice nat. size).

Fig. 2. Developing sporangia of *Comatricha typhoides* Rost. on surface of decayed fallen horse-chestnut tree. (just below nat. size).

PLATE XXXIV

Fig. 1. Group of recently developed *Stemonitis ferruginea* Ehrenb. on same horse-chestnut tree (half nat. size).

Fig. 2. *Leocarpus fragilis* Rost. The plasmodium had crept some distance up the stem of a living bramble and had there formed sporangia ($\frac{2}{3}$ nat. size).

NORFOLK MYCETOZOA

As was remarked at the outset of this paper, records of the Mycetozoa found in the county of Norfolk have appeared at somewhat wide intervals in the Transactions of our Society During the fourteen years that the writer has been working upon the group many alterations in nomenclature have taken place and the number of species recorded has been nearly doubled ; and it was felt that a list of species recorded to date with a comparative table showing how the distribution compares with other parts of the country which have been systematically

worked would not only be a contribution to the natural history of our county but also be of use to workers in the group.

The climate of Norfolk is, generally speaking, dry; the average rainfall for the past thirty-five years as recorded in Norwich by Mr. Arthur Preston, F.R.Met.Soc. being 26.48 inches, a fact not apparently favourable to the development of such moisture-loving creatures as the Mycetozoa. Most of the woods are comparatively small, and, being closely preserved for game-rearing, are inaccessible to the mycologist during certain parts of the year. I have only had opportunities for paying regular visits to localities within a few miles of Norwich owing to limited leisure, but the record as seen from the comparative table is a fairly extensive one. More observers are needed in other parts of the county, for, if more ground were covered, the number of species would doubtless be increased and a better knowledge of the distribution of this extremely interesting but little-known group would be obtained. The present list contains 121 species of which the writer has personally recorded 116 species, 60 being new records for the county, including one species new to Britain, and two varietal forms new to science.

The first records of Mycetozoa appear in the lists of Norfolk Fungi by that gifted mycologist Dr. Plowright, of King's Lynn (see Trans. Norf. and Norw. Nat Soc., Vol. I. p.47, 1873; iii. p. 741, 1884). Further records were made by W. H. Burrell, F.L.S., who did much valuable work upon the group; he was furnished with additional data by Mr. L. R. J Horn, of Woodton, near Bungay (op. cit. vi. 449 1898; ix. 106, 1910).

The localities in which my researches have been carried out are chiefly Whitlingham woods, Dunston woods, a small fir wood belonging to the Earlham Hall estate, Buckenham and Strumpshaw woods, the wood belonging to Mousehold House, Stratton Strawless woods, Costessey Hall woods, and those at Thorpe which belonged to the late Sir Eustace Gurney. I should like to say how deeply I am indebted to the various owners for permission to visit these woods from time to time. I should also like to extend my thanks to Mr. Burrell of Leeds, who has kindly given me assistance with regards to previous records, to Messrs. H. Springall and Cockle of King's Lynn for forwarding a considerable amount of material collected in

their neighbourhood, and to Mr. Reginald Gaze who has brought me a number of specimens from the Costessey woods. Those species which have been previously recorded and have not been met with by the author are marked with an asterisk (*).

Ceratiomyxa fruticulosa Macbr. Very abundant in June and July on decaying pine wood in most localities ; a pinkish form is occasionally met with.

Badhamia capsulifera Berk. The chrome-yellow plasmodium was met with on twigs and dead leaves on the ground at Stratton Strawless in February and matured indoors to typical sporangia. The species was also found on a stump at Spixworth by Dr. Plowright.

B. utricularis Berk. Fairly common ; it has occurred in the Whitlingham, Buckenham, and Racecourse woods ; a very large gathering was also obtained from the Reffley woods, King's Lynn. Has been met with throughout the year upon leathery fungi ; a very large gathering covering several inches was made in January upon some dead horse-chestnut logs.

**B. nitens* Berk. Two records have been made of this, one on a dead oak branch in Reffley woods.

B. macrocarpa Rost. A large gathering of sessile sporangia was made on the bark of a fallen poplar in July ; a stalked form was found on bark in the August of the succeeding year. Both gatherings were made at Whitlingham.

B. panicea Rost. Fairly common on dead wood and old ivy stems, April to September.

B. foliicola List. On dead branches, Dunston, Earlham, and Whitlingham woods in summer and autumn. On two occasions it was found in a heap of dead branches partly covered with leaves.

B. rubiginosa Rost. var. *dictyospora* List. Two large gatherings were made upon dead brambles and bracken in the Mousehold House woods in Oct. 1920, 1922, and 1924.

Physarum leucopus Link. Two gatherings of this were made in Stratton Strawless woods, one on birch bark, the other on birch leaves in December.

Physarum psittacinum Ditm. Gathered on old pine stumps in Buckenham and Melton Constable woods, July and August.

P. penetrale Rex. Large colonies of this rare species were found in Dunston, Mousehold House, and Bramerton woods

on dead bracken and brambles, July and August. The only other British record is from Luton (Beds); it also occurs in Ireland.

P. carneum G. List. & Sturgis. Found for several years in succession in the Mousehold House woods in late summer and early autumn (see Journ. R.M.S. 1917, p. 265). With the exception of a small gathering made near Lisbon by Dr. Torrend, this interesting species has only been met with elsewhere in Colorado, U.S.A.

P. viride Pers. The typical form is common on dead wood in summer. *Var. incanum* List. On mossy bark in the racecourse Plantation, Thorpe, also on dead bramble in Mousehold House woods, in October.

P. galbeum Wing. On dead bramble and bracken in bramble thickets in Buckenham, Dunston, and Mousehold House woods, July to October, especially after rain.

P. nutans Pers. Very common on dead wood everywhere throughout the year, is sometimes associated with a limeless form known as var. *violascens*. Var. *leucophæum* List. is also fairly common.

P. pusillum List. On dead ivy stems at Whitlingham; a smaller neat form occurred on straw heaps at Earlham; summer and early autumn.

P. compressum Alb. & Schwein. On dead wood and bark, fairly common throughout the year. A very large growth was seen at Earlham in July covering old cabbage-stalks thrown into a heap.

P. straminipes List. On old straw heaps at Whitlingham, Earlham, and Dunston, July and August.

P. didermoides Rost. On an old straw heap at Swainsthorpe in September in great abundance.

P. cinereum Pers. Common on dead and living leaves, April to September.

P. vernum Somn. The typical form is not common; var. *iridescens* G. List. is fairly abundant on dead leaves and bracken in the Mousehold House woods during summer.

P. sinuosum Weinm. Frequent on dead leaves and bramble-stems, June to September.

P. bitectum List. In similar habitats to the preceding, July to January.

P. contextum Pers. Two gatherings of this were made ; one on dead ivy at Earlham in November, the other maturing from yellow plasmodium on larch needles in Whitlingham woods in July.

P. gyrosum Rost. Found in Feb. 1922 by Mr. A. Adcock, of Upton Road, Norwich, in a cucumber-house. It had matured upon a dead stick ; a fine group of sporangia were seen by the writer two days afterwards upon humus formed of decaying beech leaves in the same greenhouse. In Feb. 1928, Mr. Adcock again noticed this species which had matured upon a living cucumber leaf where the plasmodium had crept from the humus ; this was in a cucumber-house belonging to Mr. Ernest Morse of Eaton. A considerable number of gatherings of the species were made upon soil, dead leaves and twigs. In March of the same year Mr. Morse reported an abundance of sporangia in the cucumber-houses upon soil and leaves. In some cases the plasmodium had crept up the side of the flower-pots and matured in patches three inches square. In June 1919 this interesting species was found in a greenhouse in the Edinburgh Botanical Gardens by Dr. M. Wilson, F.L.S., who cultivated the plasmodium (fed on bread) from spores. Probably Berkeley's *Didymium dædalium*, described as occurring in great abundance in a cucumber-frame at Milton, Northants, in 1850, was this species ; apart from this the Norwich gatherings are the only English records known.

P. lateritium (Berk. & Rav.) Morg. On dead wood at Dunston ; also in abundance on dead leaves beneath low bramble growths in Mousehold House woods ; it matured from yellow plasmodium—a fact not previously recorded—and occurred in July, August, and September. The only other British record is on holly leaves near Smethwick, Staffs, by Mr. A. Camm.

P. virescens Ditm. On moss, Whitlingham, at Elsing, near East Dereham, and at Horsford, in the last two cases maturing from yellow plasmodium ; July and August ; also obtained from Stratton Strawless (W.H.B.). Var. *obscurum* Lister. has been frequently found in the interior of dense bramble clumps in Mousehold House woods in July and August.

Fuligo septica Gmel. Very common, May to August. It usually occurs on old stumps, and has been noted on sawdust

heaps and on living bracken-stems. Var. *rufa* List. has been met with in three successive years on a fallen horse-chestnut tree in December at Whitlingham. Var. *candida* R.E. Fries, several gatherings were made on soil, and stems of living cucumber plants in cucumber-houses at Eaton in February.

F. cinerea Morg. On old straw, scattered over a small area, and looking like the droppings of large birds; found in July at Earlham. Var. *ecorticata* List. was found in Earlham fir wood on earth and husks of wheat in July.

Craterium minutum Fr. Common on dead leaves, straw, and twigs throughout the year.

C. leucocephalum Ditm. Common on dead holly and oak leaves throughout the summer.

C. aureum Fr. Has occurred at Whitlingham, Dunston, Mousehold House, and King's Lynn, on dead leaves throughout the summer.

Leocarpus fragilis Rost. Frequent on dead and living bracken, dead leaves, and often on pine needles, during summer.

Diderma spumarioides Fr. Fairly frequent on dead leaves, March to August. Fine gathering on dead rushes, Hoveton St. John, October.

D. globosum Pers. A fine gathering of this species, which is rare in Britain, was made on dead grass-stems and moss in a boggy alder copse at Buckenham in October; a small specimen was found in similar surroundings on a piece of dead wood in the Strumpshaw woods in July, and Mr. J. Saunders gathered it at Holt in October 1897. All the Norfolk gatherings are of a form intermediate between typical *D. globosum* and *D. spumarioides*, having the eggshell-like walls of the former and spores measuring only 9–10 μ.

D. testaceum Pers. On dead leaves in Mousehold House woods, August, September.

D. hemisphericum Hornem. On dead leaves, stems, twigs and old straw, Whitlingham, Earlham, Cringleford, and Mousehold House Woods, July to November.

D. effusum Morg. On dead leaves, bracken, and dead herbaceous stems in Mousehold House, Buckenham, Stratton Strawless, and Earlham woods, July to November.

D. deplanatum Fr. One gathering on dead bramble stems in Mousehold House woods, September. Four gatherings

were made in October and November on mossy stumps in Stratton Strawless woods.

D. simplex List. A large gathering of this uncommon species on dead leaves under low brambles during August in Dunston woods ; the sporangia were pale drab in colour.

D. radiatum List. On mossy pine branch, Whitlingham, Stratton Strawless, October and November. Var. *umbilicatum* Meylan. On dead pine wood at Earlham and Stratton Strawless in November.

D. montanum Meylan. A single gathering was made on dead wood in the Stratton Strawless woods in October. The spores are paler, smoother and smaller than those of *D. radiatum* var. *umbilicatum* with which it is closely allied.

D. floriforme Pers. Seen in all stages of development on dead wood and bracken in Dunston woods in August ; also in the same woods and in Mousehold House woods in September.

**D. asteroides* List. The first British gathering of this species was made in Oct. 1910 by Mr. W. H. Burrell upon stems of *Equisetum palustre* on marshy ground on Flordon Common.

Diachea leucopoda Rost. Fairly common on dead brambles, bracken, etc., during summer in Mousehold House, Whitlingham, and Dunston woods. In July 1916 in Mousehold House woods a large colony was found with an interesting variety of forms. All stages occurred between typical cylindrical sporangia with white stalks and sessile globose limeless sporangia or even short plasmodiocraps. Var. *globosa* List. This appears to be the only British gathering of this form, which has been recorded from Switzerland, Java, Japan, New Hampshire, and Chili.

**D. subsessilis* Peck. Found at Holt by J. and E. Saunders (see Trans. N. N. N. S. vi. 451).

Didymium difforme Duby. Common everywhere on dead leaves, straw, and decaying herbaceous stems throughout the year.

D. vaccinum (Dur. & Mont.) Buchet (*D. Trochus* List.). In fair abundance amongst the under layers of decaying straw forming the bottom of an old stack at Swainsthorpe in September.

D. complanatum Rost. On bracken, bramble-stems, and moss in Dunston, Mousehold House, and Earlham woods during summer.

D. Clavus Rabenh. Fairly common on dead leaves and decaying herbaceous stems, July to November.

D. melanospermum Macbr. On dead leaves and twigs in Buckenham, Dunston, and Mousehold House woods during summer. Var. *minus* List. One gathering in Mousehold House woods on dead leaves in September.

D. nigripes Fr. On dead leaves in Buckenham and Earlham woods during summer. Var. *xanthopus* Fr. is much more common and occurs in summer in similar habitats.

D. squamulosum Fr. An exceedingly common and protean species, occurring throughout the year. An iridescent form has been met with, and in the summer of 1922 flat specimens resembling *D. complanatum* were found on leaves of *Nepeta glechoma*.

Mucilago spongiosa Morg. Plowright mentions this species as being very common, but I have gathered it only four times—once on wild raspberry-canes in November at Earlham (between 1914 and 1922), and during the summer of 1922 two large growths on *Nepeta glechoma* at Earlham and Whitlingham, also on same plant by roadside at Stratton Strawless in November 1927.

Lepidoderma tigrinum Rost. A single gathering of this species was made at Felthorpe in Oct. 1927. The sporangia were just in the immature orange-yellow stage emerging from moss under a small sweet-chestnut tree and were thus conspicuous. In the purplish-grey mature form the sporangia would have easily escaped notice.

Colloderma oculatum G. List. After several years of vain searching, this was discovered during wet weather, maturing amongst moss on a fallen tree-trunk in the Belmore Plantation, Thorpe, in October.

Stemonitis fusca Roth. Fairly common on dead wood, May to September. Var. *confluens* List. On a prostrate tree-trunk in the Whitlingham woods in August and September.

S. splendens Rost. var *flaccida* List. Has been met with several times on dead wood ; one specimen matured two feet up an erect dead pine tree, another on a painted gatepost four

feet from the ground on College Road. Whitlingham woods, May to September.

S. herbatica Peck. On an old pine stump in the garden, Thorpe, August.

S. flavogenita Jahn. On dead pine wood and old pine needles in most localities, June to September.

S. ferruginea Ehrenb. A large gathering appeared during three successive seasons on a fallen horse-chestnut trunk in the Whitlingham woods ; it has also been found on dead wood at Dunston ; May to September.

S. hyperopta Meylan. Fairly common on coniferous wood in most localities, May to August. Var. *microspora* List. On dead wood, Whitlingham, August.

Comatricha nigra Schroet. Common on dead branches and sticks during every month. Var. *alta* List. On dead wood in the Whitlingham woods, February to April.

C. laxa Rost. on dead wood Costessey, Sept. 1924.

C. fimbriata G. List. & Cran. Two gatherings of this tiny species were made on dead pine wood in the Whitlingham and Earlham woods in September.

C. elegans List. A single colony was found on a dead oak twig in the Mousehold House woods in July.

C. lurida List. On dead leaves under holly bush, Stratton Strawless, November. This was at first taken for *Lamproderma scintillans* Morg. which it superficially resembled.

C. typhoides Rost. Fairly common on dead wood from May to September ; it appeared for several years on a fallen horse-chestnut trunk in the Whitlingham woods.

C. pulchella Rost. Abundant on dead leaves and bracken in Mousehold House woods, and less so in the Dunston and Whitlingham woods ; in summer.

C. tenerrima G. List. On dead wood, once on straw ; at Earlham and Whitlingham, August to November.

C. rubens List. On dead coniferous wood at Earlham in November.

Enerthenema papillatum Rost. Fairly common, chiefly on dead pine trunks and on horse-chestnut logs, in all localities, March to September.

Lamproderma columbinum Rost. One gathering was found on a mossy log in Whitlingham woods maturing from white

plasmodium. In Nov. 1927 a very large freshly developed growth was found on a mossy prostrate pine trunk in Stratton Strawless woods. Scattered among the sporangia were noticed those of a small *Cribraria* which proved to be the first British gathering of *Cribraria piriformis* Schrad. var. *fusco-atra* Meylan (q.v.)

L. arcyrionema Rost. A single gathering of this, which is uncommon in Britain, was made on dead wood, probably beech, in the Whitlingham woods in July.

L. scintillans Morg. Abundant throughout the year on leaf heaps, particularly beech, in all localities.

L. violaceum Rost. Two large gatherings on a mossy tree-trunk in the Whitlingham woods during November and December; on one occasion a few sporangia were found maturing on the pileus of a small fungus.

L. atrosporum Meylan var. *debile* G. List. & Howard and var. *anglicum* G. List. & Howard. Both were found in considerable abundance and close together in 1918, 1920, and 1923, upon the same two heaps of beech leaves in Whitlingham woods (see Journ. Bot. 1919, 25, pl. 552). The typical form of the species has not been recorded in Britain.

L. Gulielmæ Meylan. A few sporangia were found on a beech scale in the Earlham woods in Nov. 1918; the only other British gathering was made by the Rev. W. Cran in Aberdeenshire in Sept. 1913.

**Amaurochæte fuliginosa* Macbr. Found at Sheringham by Mr. W. H. Burrell.

Brefeldia maxima Rost. A small gathering on an old elder log in the Strumpshaw woods in May. In Nov. 1926 a number of the large purplish-brown æthalia were found at Cringleford covering sticks and living ivy leaves at the foot of a tree; they had just formed and appeared like droppings of very large birds.

Cribraria argillacea Pers. Common on dead wood in summer.

C. rufa Rost. On dead coniferous wood in Earlham and Mousehold House woods during November.

C. vulgaris Schrad. Very common on fallen pine logs during summer; often forms large colonies, especially in the Whitlingham and Buckenham woods. Var. *aurantiaca* Pers. Appears at the same time and places.

C. tenella Schrad. A single large gathering was made in the Whitlingham woods on a dead pine trunk in July.

C. piriformis Schrad. var. *fusco-atra* Meylan. This was found scattered over a small area in company with *Lamproderma columbinum* on a moss-covered fallen pine log in Stratton Strawless woods in Nov. 1927. The plasmodic granules were found to be very small being only 1 to 1.5μ in diameter and this is the first British record of this variety which has so far only occurred in the Jura Mts. of Switzerland.

Dictydium cancellatum Macbr. After a spell of wet weather the developing sporangia form a remarkable sight ; the rain-sodden pine logs are covered for several feet with the purple-black moist sporangia which quickly change to red-brown on maturing. It is fairly common in all localities visited. Var. *fuscum* List. also appears on dead coniferous wood, but has been recorded only in the Whitlingham woods in summer.

Licea flexuosa Pers. Frequent on dead pine branches in the Whitlingham, Earlham, and Racecourse woods in summer.

**Orcadella operculata* Wing. The first gathering of this minute species outside North America was made by Mr. Burrell in 1908 on *Frullania dilatata* and other small liverworts on a beech tree at Nash's Grove, Stratton Strawless (see Trans. N. N. N. S. ix. 106).

Tubifera ferruginosa Gmel. Common on pine logs in the Whitlingham and Buckenham woods during summer ; also recorded from Stratton Strawless.

Dictydæthalium plumbeum Rost. Not uncommon on dead wood in the Dunston and Whitlingham woods throughout the year.

Enteridium olivaceum Ehrenb. On dead wood at Dunston in March ; two gatherings on dead branches in Stratton Strawless woods in December.

E. liceoides G. List. A single gathering on dead pine wood at Earlham in November.

Reticularia Lycoperdon Bull. Common in various situations ; on one occasion it was seen maturing on the end of a recently cut willow in the full sun, and on another occasion four silvery white æthalia were seen five feet up the trunks of living limes n a city churchyard.

Liceopsis lobata Torrend. A single gathering of this some-

what rare species was found on an old pine stump at Dunston in July.

Lycogala flavofuscum Rost. A large æthalium was found upon a rotting stump, probably elm, in the Whitlingham woods in August.

L. epidendrum Fr. One of the earliest species to appear in spring ; the developing æthalia are often very numerous and conspicuous : very common on dead wood, April to September.

Trichia favoginea Pers. In Plowright's List (Trans. Norf. Norw. Nat. Soc. i. 47) occur *T. turbinata* and *T. chrysosperma*, which are now regarded as synonymous with *T. favoginea*. Plowright probably followed Berkeley's classification in Smith's *English Flora ;* he mentions both species as occurring commonly. The writer has only once met with *T. favoginea* in the county, when it occurred as a large patch on bark upon an old sawdust heap in the Costessey Hall woods ; the previous records probably refer to either *T. scabra*, *T. persimilis*, or *T. affinis*, which only came to be recognised after Berkeley's time.

T. verrucosa Berk. A single gathering was made on moss covering an old stump in Stratton Strawless woods in November.

T. affinis de Bary. On decaying logs at Whitlingham and elsewhere throughout the year.

T. persimilis Karst. Very common on decaying wood in all localities ; found all the year round, but more abundant from November to April.

T. scabra Rost. Occurred for successive years on decaying tree-trunks in Whitlingham woods ; the colonies of sporangia found in winter were often very large and were occasionally associated with *Hemitrichia vesparium*. It has also occurred in the Stratton Strawless woods.

T. varia Pers. Very common on dead wood in all localities visited, September to March.

T. contorta Rost. Found occasionally in Whitlingham woods March and April. Var. *inconspicua* List. in the same woods from May to August.

T. lutescens List. A few scattered sporangia of this rare species were found in July on a dead alder branch which had been submerged in a wide ditch that was still in a boggy

condition; after removing the sporangia the branch was returned to the ditch and a further gathering was found on it in the following October. The gatherings were made in the Belmore Plantation, Thorpe.

T. decipiens Macbr. Common in early spring in the Whitlingham, Dunston, and Earlham woods. It also occurs less frequently throughout the year, maturing sporangia being found in August upon beech and horse-chestnut wood.

T. Botrytis Pers. occurs on dead wood during most months of the year at Whitlingham, and has been frequently found in the Stratton Strawless woods in autumn and winter; also obtained from Woodton near Bungay (L. R. J. Horn). Var. *flavicoma* List. was found on dead holly leaves in Mousehold House woods, and a solitary specimen on a pine needle at Earlham. Var *munda* List. This has occurred frequently on dead wood in the Belmore Plantation, Thorpe, at Costessey and in the Stratton Strawless woods in the autumn and winter; also recorded from Beeston Regis (W. H. Burrell).

Hemitrichia vesparium Macbr. Several gatherings were made in winter in the Whitlingham woods on a rotting fallen tree; it has also been recorded from Ringland, and in Nov. 1927 a very large growth was seen in the interior of a fallen decayed tree at Stratton Strawless.

H. clavata Rost. Common on decaying horse-chestnut wood in the Whitlingham woods during spring.

H. minor G. List. The tiny scattered sporangia were found on the mossy trunk of a living sycamore some four or five feet from the ground in the Whitlingham woods in the early part of November; they were discovered with the aid of a reading-glass.

Arcyria ferruginea Sauter. On dead wood in all localities during most months

A. cinerea Rost. Fairly common on dead wood in summer.

A. pomiformis Rost. Found chiefly on dead oak wood in various localities, June to September.

A. denudata Wettst. Common on rotten wood during most months; it has been found maturing upon bare earth, whence the plasmodium had probably crept from decayed wood.

A. incarnata Pers. Frequent on dead branches, especially

oak, April to November. Var. *fulgens* List. Two gatherings on rotting beech wood at Whitlingham in January and May.

A. nutans Grev. Common, particularly on dead oak logs, May to September.

Perichæna depressa Libert. On the bark of dead branches and old ivy stems from January to May, and in October and November in the Whitlingham woods; also at Cringleford on dead bark, October.

P. corticalis Rost. On the bark of fallen trees, e.g. ash, poplar, at Buckenham, Whitlingham, Stratton Strawless, and Hoveton St. John during most months of the year.

P. vermicularis Rost. A single gathering on dead beech leaves in the Whitlingham woods during August.

Margarita metallica List. This beautiful species was found in June scattered over some old larch cones in a small hollow on Ipswich Road, Norwich; also with *Perichæna corticalis*, on dead wood at Whitlingham in December and on dead coniferous wood at Dunston in June.

Dianema depressum List. Seven gatherings have been made in March and April, and one in December. At Whitlingham, it usually occurred on heaps of stripped willow bark; at Dunston it was on dead wood.

Prototrichia metallica Mass. On dead wood in the Whitlingham woods, March and April 1915, and at Costessey on dead wood in Sept. 1924.

Comparative Table of MYCETOZOA recorded from the Counties of (1) NORFOLK, (2) ESSEX, (3) SURREY, (4) BEDS., BUCKS., and HERTS., (5) SOMERSET and DEVON, (6) ABERDEEN, ELGIN, and NAIRN.

H. marks the records first made by the author in Norfolk.
Ha. marks those first made by N. G. Hadden in Somerset and Devon.
A. marks those first made by P. J. Alexander in Surrey.
C. those made by Rev. W. Cran in Aberdeenshire

	Norfolk. (1)	Essex. (2)	Surrey. (3)	Beds., Bucks, and Herts. (4)	Somerset and Devon. (5)	Counties of Aberdeen, Elgin and Nairn. (6)
Ceratiomyxa fruticulosa (Muell) Macbr. ..	*	*	*	*	*	*
Badhamia capsulifera (Bull) Berk. ..	*	—	*	*	*	C
B. populina Lister	—	*	—	—	—	—

	(1)	(2)	(3)	(4)	(5)	(6)
B. utricularis (Bull) Berk	*	*	A	*	*	C
B. nitens Berk.	*	—	*	*	*	—
,, ,, var. *reticulata* G. Lister ..	—	—	—	—	*	—
B. versicolor Lister	—	—	—	—	—	C
B. decipiens (Curt) Berk.	—	—	—	—	—	C
B. macrocarpa (Ces) Berk.	H	*	A	*	*	—
B. affinis Rost.	—	—	—	—	—	C
B. panicea (Fries) Rost.	*	*	*	*	*	C
B. foliicola List.	H	*	*	*	*	C
B. ovispora Racib.	—	—	—	*	—	—
B. lilacina (Fries) Rost.	—	*	—	—	—	—
B. rubiginosa (Chev.) Rost.var. *dictyospora* Lister	H	*	—	*	—	—
B. rubiginosa (Chev.) Rost. var. *globosa* Lister	—	—	—	—	*	*
Physarum leucopus Link.	H	—	—	—	*	—
P. globuliferum (Bull.) Pers.	—	—	A	—	—	C
P. murinum Lister	—	—	—	—	—	C
P. citrinum Schum	—	—	—	*	—	*
P. luteo-album Lister	—	—	—	—	*	—
P. nucleatum Rex.	—	—	—	—	Ha	—
P. psittacinum Ditmar	*	—	—	*	*	—
P. penetrale Rex.	H	—	—	*	—	—
P. carneum G. Lister & Sturgis	H	—	—	—	—	—
P. viride Pers.	*	*	*	*	*	*
,, ,, var. *aurantium* Lister ..	—	*	*	*	*	C
,, ,, var. *incanum* Lister ..	H	*	—	—	—	C
P. galbeum Wing.	H	—	*	—	—	—
P. auriscalpium Cooke	—	—	A	—	—	C
P. nutans Pers.	*	*	*	*	*	*
,, ,, var. *leucophaeum* Lister	*	*	*	*	*	*
,, ,, var. *robustum* Lister ..	—	*	*	*	—	—
P. crateriforme Petch	—	—	A	—	—	C
P. pusillum (Berk. & Br.) Lister	*	*	*	*	*	*
P. compressum Alb. & Schw.	*	*	A	*	*	*
P. connatum (Peck) Lister	—	—	—	*	—	—
P. straminipes Lister	*	—	A	*	*	C
P. didermoides (Ach.) Rost..	*	—	A	*	—	—
,, ,, var. *lividum* List.	—	—	—	*	—	—
P. mutabile (Rost.) Lister.	—	—	*	*	—	—
P. cinereum Pers.	*	*	*	*	*	*
P. vernum Somm.	H	—	*	*	*	C
,, ,, var. *iridescens* Lister. ..	H	*	—	*	*	—
P. gyrosum Rost.	H	—	—	—	—	—
P. sinuosum (Bull.) Weinm	H	*	*	*	*	—
P. bitectum Lister	H	*	*	*	*	—
P. contextum Pers.	H	—	*	*	*	C
P. conglomeratum Rost.	—	—	—	*	*	*
P. lateritium Morgan	H	—	—	—	—	—
P. virescens Ditmar	*	*	*	*	*	C
,, ,, var. *nitens* Lister ..	—	—	—	*	—	C
,, ,, var. *obscurum* Lister	H	*	—	*	*	C
Fuligo septica (L.) Gmel.	*	*	*	*	*	*
,, ,, ,, ,, var. *candida* Lister	H	—	*	—	—	—
,, ,, ,, ,, var. *rufa* Lister	H	—	*	—	—	—
F. muscorum Alb. & Schwein	—	*	*	*	*	*
F. cinerea (Schw.) Morgan	H	*	A	*	—	—

	(1)	(2)	(3)	(4)	(5)	(6)
F. cinerea (Schw.) var. *ecorticata* List ..	H	*	—	*	—	*
Craterium minutum (Leers.) Fr.	*	*	*	*	*	C
C. leucocephalum Ditmar	*	*	*	*	*	*
C. aureum (Schum.) Rost.	H	*	*	*	*	C
Leocarpus fragilis (Dicks.) Rost.	*	*	*	*	*	C
Diderma montanum Meylan	H	*	A	—	*	—
D. spumarioides Fries.	H	*	*	*	*	C
D. globosum Pers.	*	—	—	—	—	—
D. testaceum Pers.	H	—	*	*	*	—
D. hemisphericum (Bull.) Hornem. ..	*	—	*	*	*	C
D. effusum (Schw.) Morgan.	H	*	A	*	*	*
D. arboreum G. Lister & Petch	—	—	—	—	*	C
D. deplanatum Fries.	H	*	A	*	—	—
D. simplex (Schroet.) Lister	H	—	—	—	—	C
D. Trevelyani Fries.	—	—	—	—	—	C
D. ochraceum G. F. Hoffman.	—	—	—	—	Ha	*
D. radiatum (L.) Rost	H	—	—	—	—	—
,, ,, var. *umbilicatum* Meylan	H	*	—	*	*	C
D. floriforme Pers.	H	*	*	*	Ha	C
D. asteroides Lister	*	—	H	—	—	C
Diachæa leucopoda Rost.	H	*	*	*	*	—
,, ,, ,, var. *globosa* Lister	H	—	—	—	—	—
D. subsessilis Peck.	*	—	—	*	—	—
D. cerifera G. Lister	—	—	—	—	*	—
Didymium difforme (Pers.) Duby. ..	*	*	*	*	*	C
,, ,, var. *comatum* List.	—	*	—	*	—	—
,, ,, var. *repandum* List.	*	—	*	*	*	—
D. trachysporum G. Lister	—	*	*	*	—	*
D. vaccinum Buchet	H	*	*	*	—	*
D. dubium Rost.	—	—	*	—	*	*
D. anomalum Sturgis	—	*	A	—	—	—
D. complanatum Rost.	H	*	—	*	*	—
D. Clavus (Alb. & Schw.) Rost.	H	*	*	*	*	C
D. melanospermum (Pers.) Macbr. ..	*	*	*	*	*	*
,, ,, var. *minus* List.	H	*	*	*	*	C
D. nigripes Fries.	*	*	*	*	*	C
,, ,, var. *eximium* Lister ..	—	*	*	—	—	—
,, ,, var. *xanthopus* Lister ..	H	*	*	*	*	*
D. squamulosum (Alb. & Schw.) Fries. ..	*	*	*	*	*	*
D. anellus Morgan	—	*	*	*	—	—
D. crustaceum Fries	—	—	*	—	*	—
Mucilago spongiosa (Leysser) Morgan. ..	*	—	*	*	*	C
,, ,, var. *dictyospora* Lister	—	—	—	*	—	—
Lepidoderma tigrinum (Schrad.) Rost. ..	H	—	—	*	Ha	C
L. Chailletii Rost.	—	—	—	*	*	—
Leptoderma iridescens G. Lister	—	—	—	*	Ha	*
Colloderma oculatum (Lipp.) G. Lister ..	H	*	A	*	Ha	C
Stemonitis fusca Roth.	*	*	*	*	*	*
,, ,, var. *rufescens* Lister ..	—	*	—	*	*	*
,, ,, var. *confluens* Lister ..	H	*	*	*	*	—
,, ,, var. *flaccida* Lister ..	—	—	*	—	—	—
S. splendens Rost. var. *flaccida* Lister ..	*	*	*	*	*	C
S. confluens Cooke & Ellis	—	*	*	*	*	*
S. herbatica Peck.	H	*	*	*	Ha	*
,, ,, var. *confluens* Lister ..	—	*	—	—	—	—
S. flavogenita Jahn.	H	*	*	*	*	C
S. ferruginea Ehrenb.	H	*	*	*	Ha	C

	(1)	(2)	(3)	(4)	(5)	(6)
S. ferruginea Ehrenb. var. *Smithii* Lister ..	—	*	—	—	—	*
S. hyperopta Meylan.	H	—	*	*	—	C
,, ,, var. *microspora* Lister	H	*	*	—	*	—
Comatricha nigra (Pers.) Schroet	*	*	*	*	*	*
,, ,, ,, var. *alta* Lister ..	H	*	*	*	*	—
,, ,, ,, var. *æqualis* Sturgis	—	—	—	—	—	*
C. laxa Rost.	H	*	*	*	*	C
C. fimbriata G. Lister & Cran.	H	*	*	—	—	C
C. cornea G. Lister & Cran.	—	—	—	—	—	C
C. elegans (Rac.) Lister	H	*	*	*	Ha	C
C. lurida Lister.	H	—	*	*	*	*
C. typhoides (Bull.) Rost.	*	*	*	*	*	C
C. pulchella (Bab.) Rost.	H	*	*	*	*	C
,, ,, var. *fusca* Lister ..	—	*	*	—	*	*
C. tenerrima Lister	H	—	*	*	*	C
C. rubens Lister	H	*	*	*	*	*
Enerthenema papillatum (Pers.) Rost. ..	*	*	*	*	*	C
Lamproderma columbinum Rost.	H	—	*	*	Ha	C
,, ,, var. *iridescens* G. Lister	—	—	—	—	—	*
,, ,, var. *brevipes* G. Lister	—	—	—	—	*	*
L. echinulatum Rost.	—	—	—	—	*	*
L. arcyrionema Rost.	H	*	—	*	*	—
L. scintillans (Berk. & Br.) Morgan ..	*	*	*	*	*	C
L. violaceum (Fr.) Rost.	H	*	*	*	*	C
L. Gulielmæ Meylan	H	—	—	—	—	C
L. cribrarioides R. E. Fries.	—	—	—	—	—	C
L. atrosporum var. *debile* G. Lister & Howard	H	—	—	—	—	—
,, var. *anglicum* G. Lister & Howard	H	—	—	—	—	—
L. insessum G. Lister	—	—	—	—	—	*
Echinostelium minutum de Bary	—	—	—	—	—	C
Amaurochæte fuliginosa (Sow.) Macbr. ..	*	*	*	*	*	*
Brefeldia maxima (Fr.) Rost.	H	*	*	*	*	*
Lindbladia effusa (Ehren.) Rost.	—	—	*	*	—	*
Cribraria argillacea Pers.	*	*	*	*	*	*
C. rufa (Roth.) Rost.	H	*	*	*	Ha	C
C. macrocarpa Schrad	—	—	—	—	—	*
C. vulgaris Schrad	*	*	*	*	*	*
C. vulgaris Schrad var. *aurantiaca* Pers. ..	*	*	*	*	*	*
C. tenella Schrad.	H	—	*	—	—	—
C. piriformis Schrad	—	—	—	—	*	*
,, ,, var. *notabilis* Rex. ..	—	—	*	—	—	—
,, , var. *fusco-atra* Meylan	H	—	—	—	—	—
C. violacea Rex.	—	—	—	*	*	C
Dictydium cancellatum (Batsch) Macbr. ..	*	*	*	*	*	*
,, ,, var. *fuscum* Lister ..	H	*	*	*	*	C
Licea flexuosa Pers.	*	*	—	*	Ha	C
L. pusilla Schrad.	—	—	*	—	—	*
L. minima Fries	—	—	*	*	—	C
L. castanea G. Lister	—	—	—	—	—	C
L. tenera Jahn.	—	*	—	—	—	—
Hymenobolina parasitica Zukal	—	—	—	—	—	C
Orcadella operculata Wingate	*	—	—	—	—	C
,, ,, var. *sessile* G. Lister ..	—	—	—	—	Ha	—
Tubifera ferruginosa Gmel.	*	*	*	*	*	*
Dictydaethalium plumbeum (Schum.) Rost.	*	*	*	*	*	C
Enteridium olivaceum Ehrenb.	*	*	*	*	—	C
E. liceoides G. Lister	H	—	*	—	*	—

	(1)	(2)	(3)	(4)	(5)	(6)
Reticularia Lycoperdon Bull.	*	*	*	*	*	C
Liceopsis lobata (Lister.) Torrend.	H	*	*	*	—	*
Lycogala flavofuscum Rost.	H	—	A	*	—	—
L. epidendrum Fries	*	*	*	*	*	—
Trichia favoginea Pers.	H	—	—	*	*	—
T. verrucosa Berk.	H	*	A	—	—	*
T. affinis De Bary	H	*	*	*	*	*
T. persimilis Karsten	*	*	*	*	*	*
T. scabra Rost.	H	*	*	*	*	—
T. varia Pers.	*	*	*	*	*	*
T. contorta Rost.	*	*	*	*	*	C
,, , var. *inconspicua* Lister ..	H	*	*	*	*	*
T. alpina R. E. Fries	—	—	A	—	—	—
T. lutescens Lister	H	—	A	—	*	C
T. decipiens (Pers.) Macbr.	*	*	*	*	*	*
T. Botrytis Pers.	*	*	*	*	*	*
,, ,, var *lateritia* Lister ..	—	—	—	—	*	—
,, ,, var. *munda* Lister ..	*	*	*	*	*	*
,, ,, var. *flavicoma* Lister ..	H	*	*	*	*	C
,, ,, var. *cerifera* G. Lister ..	—	*	*	*	*	—
T. floriformis G. Lister	—	—	*	—	—	—
Oligonema nitens Rost.	—	—	*	—	—	—
Hemitrichia vesparium (Batsch) Macbr. ..	*	*	A	*	*	—
H. intorta Lister	—	—	—	*	—	—
H. leiotricha Lister	—	*	*	*	*	C
H. clavata (Pers.) Rost.	*	—	*	*	*	—
H. Karstenii Rost.	—	—	*	*	*	C
H. abietina (Wig.) Lister	—	—	*	—	*	—
H. minor G. Lister	H	—	—	—	Ha	C
,, ,, var. *pardina* Minakata	—	—	A	—	Ha	C
H. chrysospora Lister	—	—	—	—	*	—
Arcyria ferruginea Saut.	*	*	*	*	*	C
,, ,, var. *Heterotrichia* Torrend	—	*	—	—	—	—
A. cinerea (Bull.) Pers.	*	*	*	*	*	*
A. carnea G. Lister	—	*	A	*	—	—
A. pomiformis (Leers.) Rost.	H	*	*	*	*	C
A. denudata Wettstein	*	*	*	*	*	*
A. incarnata Pers.	*	*	*	*	*	*
,, ,, var. *fulgens* Lister ..	H	*	*	*	—	—
A. stipata Lister	—	—	*	—	—	—
A. insignis Kalachbr. & Cooke	—	—	—	*	—	—
,, ,, var. *major* G. Lister	—	—	—	*	—	—
A. nutans (Bull.) Grev.	*	*	*	*	*	*
A. Oerstedtii Rost.	—	*	A	*	*	—
Lachnobolus congestus (Somm.) Lister ..	—	*	*	*	—	*
Perichæna chrysosperma (Currey.) Lister ..	—	—	—	*	*	C
P. depressa Libert	*	*	*	*	*	—
P. corticalis (Batsch.) Fries.	*	*	*	*	*	C
P. vermicularis (Schw.) Rost.	H	—	*	*	*	C
Margarita metallica (Berk. & Br.) Lister ..	*	*	*	*	*	C
Dianema Harveyi Rex.	—	—	—	*	*	C
D. depressum Lister	*	—	A	*	*	*
D. corticatum Lister	—	—	—	—	—	C
D. repens G. Lister & Cran.	—	—	—	—	Ha	C
Prototrichia metallica (Berk.) Massee ..	*	—	A	*	*	C

II

EGG-COLLECTING: ITS USES AND ABUSES

By E. C. Stuart Baker, O.B.E., M.B.O.U.

Read March 17, 1928

In coming here to talk to you about egg collecting, I feel that I am addressing an audience whose commendable keenness on the general protection of birds naturally prejudices them against egg collectors. Yet I hope I may be able to convince you that however wicked and cruel it may be under certain circumstances to collect eggs, it is possible to do so in a manner which may be of some scientific value and therefore right and excusable. Perhaps I had better admit at the start that I personally am an enthusiastic egg collector, a fact of which I believe you are all already aware. May it to some extent mitigate your feelings against me when I tell you that the eggs of English birds have not as much interest for me as those of the exotic avifauna because the latter in my opinion are of greater use in assisting me to elucidate the points on which I am working.

I have headed my talk to you "The uses and abuses of Egg-collecting," and I will take the latter first because they can be more briefly dealt with and I feel are, with you, not a matter of controversy.

Now the first great abuse of egg collecting is committed by the man who sets out to make a collection of eggs *with no end in view* other than that of amassing a number of extremely beautiful objects. Next we have the abuse of collecting committed by the man who insists on obtaining his eggs from certain definite localities without considering whether the birds are common or not in that particular place. There may of course be exceptional reasons why an egg may be desired for scientific purposes from one special area but, broadly speaking, eggs are just as valuable when collected in those places where the bird is most common as they are when collected in the area where it is most rare. Thirdly, a very common abuse of egg collecting is that of collecting a great many more eggs than is necessary for any scientific purpose conceivable. These three points may be said to cover broadly

the abuses committed by collectors. Of course there are a hundred and one other abuses but these are generally either included in the above three or they are the indirect results of them.

It is unnecessary for me even to refer to such abuses as the bribery and corruption of keepers or the pilfering of eggs from private grounds without the consent of the owner, or from sanctuaries without special licence. These are acts which simply come from want of all gentlemanly feeling and are not those exclusively of egg collectors.

Briefly, then, you will see that my own tenets are these. A man may not take an egg unless he requires it for some scientific purpose. He must be careful to obtain his eggs from those places where the birds laying them are most abundant, and he must not break the laws of his country or of ordinary gentlemanly conduct in so doing. Beyond saying that no eggs should be taken at all, I hope you will not have much fault to find with my ideas so far.

Now I come to the second part of my talk and the one in which I am afraid I shall find my audience much more antagonistic; that is, the attempt to prove to you that there are uses as well as abuses in egg collecting. As regards the term "useful" I personally consider that it may be applied to any act which increases the sum total of human knowledge. If that is so, then there are certainly some uses to be found in egg collecting. In the first place, it is now, I think, generally admitted by ornithologists and even by pure systematists that in classification it is necessary to consider the biology as well as the structure, coloration, anatomy, etc., of birds. This being accepted, then, in the life history of birds, nidification and all that it includes is undoubtedly one of the most important studies.

It is perfectly true that no sane man would ever classify a bird because of the shape, colour or construction of its eggs, but it is equally true that there is many an ornithologist who has found a bird's egg or a knowledge of its nidification a most important guide in leading him to a proper determination of that bird's place in the great class of Aves.

Perhaps I had better give you a few simple instances of this. There is a large group of birds all known as Scimitar Babblers

and formerly included in the one genus *Pomatorhinus*. These birds inhabit an area extending practically throughout the Oriental region to the Malay Islands and, after a gap, the extreme eastern islands to Australia. Now when the nidification of these birds became first known it was found that the breeding habits in the two geographical areas, east and west of the gap, were very different. Eventually it was ascertained that whilst the western group made large football-shaped nests of bamboo leaves and grass and invariably laid pure white eggs, the Scimitar Babblers of the eastern group made nests varying somewhat in character but never of the football shape, whilst they invariably laid eggs with a definite ground colour, ranging from pale grey to grey-blue, profusely marked with dots, blotches and scrawls of darker colour. Naturally one began to think that birds laying such different eggs and having such different habits of nidification might have structural characters agreeing with these other differences. Mathews and Iredale at once saw this and their examination soon proved their surmise to be correct, and it is now universally accepted that the two groups are as wide apart in all but superficial characters as they are in their habits of nidification.

Another little instance. Many years ago my old friend Dr. Hartert separated the little Indian Bush Chat *Oreicola ferrea* into two geographical sub-species, one in India and one in Burma. I myself at first refused to follow him, but when I got a series of the Burmese bird's eggs, I found that they were so different from those taken in India that I set to work to get a series of the skins also and when I obtained them I found that Hartert's definition was substantiated.

Yet another instance. Many years ago Mr. H. Stevens sent me eggs which seemed to me to be undoubtedly those of a small Reed Warbler (*Acrocephalus* species), whilst two or three years later I procured eggs of a larger form of Reed Warbler, both of which birds were breeding in the dense reed and grass Terai of the Sub-Himalayan plains. Until we got these eggs we had always looked upon Reed Warblers as birds essentially Palæarctic or Sub-Palæarctic in character. I was, however, convinced that the eggs were those of some form of this genus and I begged Mr. Stevens to do his utmost to get specimens. The two birds, however, proved to be most

elusive, but eventually I obtained series of both and I was delighted to find that my original prophecy had been correct and that I had discovered—or he had discovered—two tropical breeding forms of Reed Warbler. The above will suffice to show that even for the purpose of pure scientific classification, eggs are useful, but there are many other ways in which they are of value to science and I think that one of the most important of these is in regard to evolution.

It is fashionable nowadays to decry Darwinism and to say that the idea of environmental selection is a farce and that the germ-plasm cannot possibly carry on from one generation to another the superficial effects of environment on the individual. Partly I believe this train of thought has begun to be so dominant because many think of time in centuries rather than in millions of years, whilst it is very difficult to obtain examples of the action of environmental selection observable in a few generations of men. Of course there are a few such examples though these are often ignored or glossed over by the anti-Darwinists. Among them may be mentioned the alteration in the colour of the Chaffinch in the Canary Isles, or in that of certain of the Indian crows which have, within the memory of man, been imported from one country to another and have assumed a plumage quite different from that of the original. Some thirty or forty years ago there were no crows of the species *Corvus splendens* in part of the Malay Peninsula, but there came a great insect plague and the crow was imported from India for the purpose of fighting this plague. Now this crow is extraordinarily common in India and is spread over an immense area, but over all this area it is extremely sensitive to its environment. In the dry hot areas it is a black bird with almost white shoulders ; in the wettest and most humid areas the pale parts are nearly as dark as the dark parts ; whilst in intermediate areas the colour of the pale portion of the plumage is intermediate. The birds imported into Burma have already considerably altered in plumage to suit their environment or because of their environment.

In eggs, however, I think we have examples which show us very admirably how evolution is going on. Some of the best known examples of these I will just glance over. We find for instance that those classes of birds which breed in far northern latitudes,

where the summers are so short that there is no chance of replacing a clutch of eggs once destroyed, lay larger clutches than their southern relations do. Again, a great majority of migratory waders lay very large eggs from which the young are hatched in a more or less advanced stage and so have time to grow up rapidly and migrate with their parents after the short summer is over. We also see that these eggs, in addition to being large, are very conical in form—a shape necessary to enable the large eggs to pack in the smallest compass possible so that they can be covered in comfort by their comparatively small parent. Other eggs, also, are cone-shaped but for different reasons. We all know that Guillemots' eggs are long cone-shaped, a shape necessary so that they should not be blown off the ledges of rocks on which they are laid. If you examine the position in which these eggs are laid you will notice that the small end points towards the rock face, so that, when blown by the wind, they simply have a rotary action which blows them backwards and forwards inwardly instead of directly off the cliff, though the latter would be the result if the cones were so short in shape that they revolved on their own axis.

Then as regards colour. We have the prevailing characteristic of similarity between the egg and its surroundings in the eggs of nearly all ground-laying birds, such as Lapwings, Sandgrouse, Night-jars, etc., etc. Perhaps the most extraordinary instance of this known to me is that of the eggs of the Yellow-wattled Lapwing (*Lobivanellus malabaricus*). This bird breeds over the greater part of the Indian region and normally lays eggs which are merely small replicas of the common English Plover. There is, however, down the western coast of India, through southern Malabar and northern Travancore, a long narrow strip of red laterite country, probably some three hundred miles long by only a few miles broad. Now along the whole of this strip, the usual colour of plover's egg is a bright brick red, covered with black dots; the red colour exactly similar to that of the red soil and the black markings similar to the black nodules of ironstone which everywhere dot the ground. On either side of this red soil is rich black loam, often shallow, but always dark in colour. Here the birds lay normal coloured eggs.

Surely the only way of accounting for the extraordinary coloration of these red eggs is by environmental selection. Evidently the birds which came here to breed laid dark eggs like all the other birds of their kind and, doubtless, the great majority of these were so conspicuous against their red surroundings that they were speedily destroyed by predatory birds and vermin of all kinds. Amongst the eggs, however, were probably a certain number with a trace of red and these, being rather less conspicuous, escaped. The birds which were hatched from them laid in the same area, and amongst their eggs again, those which had the strongest trace of red survived whilst the rest were destroyed. Thus in time a bird was evolved by the process of elimination which never laid anything but red eggs and so complete adaptation to environment was finally attained.

Far more instructive, however, and even more easy to understand, are some of the extraordinary eggs laid by Cuckoos. I am perfectly well aware that people will say to me : " When a bird like a Hedge-sparrow which lays a brilliant blue egg will sit upon and hatch the dark brown egg of the Cuckoo, what is the object or use of assimilation in the two eggs ? " This remark is one of those to which I have alluded as being made by people who think of time in nothing more than centuries. My reply to it is that probably our English Cuckoo is a very modern bird ; that the process of selection is going on even in regard to Hedge-sparrow fosterers of Cuckoos ; that the percentage of refusals by these birds to sit on Cuckoos' eggs is infinitely greater than is generally supposed and, finally, we have definite indications that bluish eggs are being evolved, which it may be presumed will, in course of time, be so perfected that they will be blue like the eggs of the Hedge-sparrow itself.

If we turn from our modern bird, the English Cuckoo, to the far older forms of those Cuckoos inhabiting Oriental and Ethiopian regions, let us examine those which are best known and most numerous. First amongst these would probably come Cuckoos of the genus *Clamator*. In India we have two very ancient forms of this genus, *Clamator jacobinus* and *C. coramandus*. Now both these birds lay blue eggs and never anything else but blue eggs, whilst they equally invariably lay these in the nests of birds which themselves lay blue eggs.

Here we have a case of environmental selection completed, for the eggs of the Cuckoos so closely resemble those of the fosterer, that even human beings are often deceived by them. Further evolution is unnecessary, for all that is needed for the perpetuation of the species has been attained.

After this genus we may consider that of the Hawk-Cuckoos, *Hierococcyx*. Here we have a genus which spreads over practically the whole of tropical and sub-tropical Asia and in climatic conditions which vary greatly. There is no one range of fosterers available throughout this area for all the various species and sub-species of *Hierococcyx ;* we find therefore that whilst many types of eggs have been evolved, in each species or sub-species, the evolution is, so far as we can see, final, although it may be dimorphic or even polymorphic in the result. Thus, the common Hawk-Cuckoo (*H. varius*) is found in the plains of India, in much the same area as that occupied by *Clamator jacobinus*, throughout which birds of the genera *Argya* and *Turdoides* are extremely common, both of these laying deep blue eggs. The Cuckoo has selected these birds as foster-parents and the egg she deposits in their nests is practically indistinguishable from their own.

Then we have the large Hawk Cuckoo (*H. spaveroides*) which is a mountain breeding form, extending throughout the Himalayas to Burma, China, etc. Over nearly the whole of this region, this Cuckoo lays a glossy pale blue egg which it deposits in the nests of birds of the genus *Garrulax*. This latter genus is also exceedingly common in all the hills, and the most common species of the genus lay eggs which are pure pale to darkish blue and to which the Cuckoo's eggs have a very close resemblance. This Cuckoo, however, also breeds in the hills of Assam, where a great number of them deposit their eggs in the nests of the Great Spider Hunter (*Arachnothera magna*), which lays brown eggs ; consequently we find, that the necessity for assimilation has evolved a brown egg to match those of this particular fosterer.

Yet one more instance I will give you which is perhaps the most remarkable of all. The small Cuckoos of the genus *Caccomantis* extend over nearly the whole Oriental region to the extreme east. Throughout these vast countries small birds such as the *Cisticolas*, Tailor-Birds and Wren-Warblers are

found in great numbers and these lay eggs which vary *inter se* considerably, but they all have either white, pale blue or very pale pink grounds and are more or less blotched and marked with various sorts of red ; that is to say, these birds have eggs which are polymorphic. The Cuckoos lay eggs which are equally variable and which are also polymorphic and therefore a certain number agree with those of the fosterers and are hatched out. For some reason in the Deccan round about Hyderabad these Cuckoos have completely changed their customs and have abandoned their normal fosterers which are comparatively rare and have had to look for another. The most common little Warbler is the Yellow-Breasted Wren-Warbler (*Prinia socialis*), a little bird laying bright brick-red eggs. In this area, which is roughly twenty miles in length and breadth, the Cuckoo has adopted this Wren-Warbler as foster parent and also lays red eggs.

Here again it seems to me that this result can only have been attained by environmental selection ; that is to say, by the process of the elimination of the most unfit. It seems to me that originally the little *Caccomantis* did not breed in this area, which is very arid, but that gradually an excess supply of Cuckoos in the surrounding country pushed individuals into this small arid zone. Not finding their normal fosterers common within this area, they deposited their eggs in the nests of the bird most like those to which they had been accustomed. When this first occurred, the vast majority of Cuckoos' eggs were undoubtedly rejected but, as in the instance already quoted, a small percentage of the Cuckoos' eggs were tinged with red and so escaped detection. We have in regard to these Cuckoos eggs a very remarkable proof that the rejection of eggs by foster parents really does occur and that on a very large scale. In 1926 two field observers wrote to the Bombay Natural History Journal, the first to say that for some unknown reason the Little Warbler (*Prinia socialis*) had completely deserted the country round about Hyderabad and Trimulgherry. The second wrote to say that for some equally unknown reason the little Cuckoos which formerly laid in the nests of these Warblers had taken to depositing their eggs in the nests of the Common Wren-Warbler and Franklin's Wren-Warbler. Now these two gentlemen quite independently had observed

two points ; one, that the normal fosterer had disappeared ; and the other, that the Cuckoos had reverted to the birds generally cuckolded outside the area. Moreover the latter gentleman, Mr. D'Abreu, commented on the fact that of the many nests he found containing a Cuckoo's egg practically every one had been deserted, while the egg of the Cuckoo showed up in extraordinary contrast to that of the foster parent.

The probability, however, is that if the red-laying *Prinia* proves to be permanently no longer available as a foster parent, in process of time selection will have the reverse effect to that originally effected and the red egg of the Cuckoo will gradually be eliminated and a white or pale blue egg evolved similar to that laid by Cuckoos outside the Hyderabad surroundings.

Before closing my talk, I would like to warn protectionists on one point, not with the idea of making them take less interest in protection, but in the hopes of making their protection more efficient. Egg thieves proceed about their business as quietly as possible and the breeding birds are thus very little disturbed. If they have to go through a ternery or gullery they do so as unobtrusively as possible, passing quickly from one nest to another and harassing the parents as little as possible. This is what I would do myself, and it is possible that in nine out of ten such examinations, I would find nothing worth my taking, whilst in the tenth I might find one clutch showing some form of variation of pigmentation which I wanted for my collection. Again if I want to mark some particular bird down to its nest, I would retire into the sand-hills and watch it with my glasses, then go straight to the nest, have a look and leave it at once. Unfortunately some protectionists do not carry out this method but assemble in large parties and make the occasion a sort of picnic. They wander, several together, through the breeding haunts, sometimes frightening the birds out of their lives and very often do more damage amongst the eggs in one visit than half a dozen egg collectors would in as many inspections. Once the birds have hatched, picnics amongst them do not do much harm, but whilst they are laying or sitting, the result is very disastrous. I have no doubt you will have noticed this yourselves in reference to your Sandwich Terns, which are very easily-frightened birds and desert in colonies on very slight provocation.

There is yet one other point in regard to protection to which I should like to refer and that is the fact that Nature will never allow the *over*-protection of one bird without detriment to some other bird. This is a fact which my own observation has rubbed into me wherever I go. Our most common birds are most common because they are the most hardy and the best fitted under local conditions to compete for a living. Our most rare birds are rare simply because they are delicate or from some other cause find it hard to obtain a living in their environment. Now is it not obvious that if we continue complete protection of our most common birds the eventual result will be that they will increase to so great an extent that the most rare birds will be pushed out altogether. Such is indeed already happening in some places. For instance, the Starling has become so numerous in many parts of England that Woodpeckers and other birds which breed in holes in trees are being prevented from breeding. Similar but less obvious effects of over-protection are occurring amongst other forms of Aves in our islands.

I should like to finish by saying that in spite of my admission that I am that most wicked of human beings, an egg thief, I am most heartily with you all in your attempts at bird protection, but I want protection to be rational and practical. Bird sanctuaries properly run are undoubtedly of more use to birds than a thousand bird laws but, if we can combine the work of sanctuaries together with legislation which will give to those responsible for the sanctuaries wide powers of discretion as well as sufficient powers to defeat the unscientific and gluttonous egg collector, I think we shall have arrived at the acme of bird protection. You, in Norfolk, have deservedly a very high reputation as practical Bird Protectionists but may I say, without intending to be in anyway offensive, that you can be even more practical. You have done so much that we all demand still more, for it seems to be a law of mankind that from those who have given most and worked hardest we demand yet greater gifts and harder work.

III

THE SWAN-MARKS OF EAST NORFOLK

By N. F. Ticehurst, O.B.E., M.A., F.R.C.S.

In 1896 Professor Newton wrote (*Dict. of Birds*, p. 930) "the subject of swan-marks, elucidated by unpublished materials in the British Museum and other libraries, is one of which a compendious account, from an antiquarian and historical point of view, would be very desirable." Since this was written, and up to within the last three or four years, no work has been done in this direction, and it is with a view to making a beginning with such an account that I have compiled the following paper.

In the first place a few words are necessary as to the material upon which it is based. In the past, single rolls of marks belonging to East Norfolk have been exhibited from time to time before various societies, and remarks, mostly unpublished, have been made upon them; but with the single exception of the Blofeld and Capel rolls (*Proc. Soc. Ant*, ser. II. vol. XX.) no detailed description of them has been given, and in no instance have more than a single mark or two been illustrated. No two rolls have ever been compared in detail, so that it has never been appreciated how they supplement and correct one another, while points of interest emerge on comparison that otherwise remain in obscurity. Different rolls differ widely from one another in treatment, and it must be remembered that all are to a considerable extent the work of copyists, some of whom were more careful than others, while their ability to read the writing of earlier scribes varied within wide limits. Apart from this, the normal variation in the spelling of proper names in earlier times is notorious, while the omission of christian names is frequent, so that it is only too easy to make false deductions, and come to erroneous conclusions from the study of a single roll. Many of these can be corrected and doubtful points cleared up on comparison being made with others.

While a study of rolls (which need not be enumerated here) belonging to several other areas and a comparison of these with those of eastern Norfolk have enabled me to come to certain conclusions and bring out certain characteristic features with regard to the latter; the material upon which the main part of

this paper is based consists of fifteen rolls of marks, viz. :— Additional MSS. 4977 and 40072 in the British Museum, each being a mixed roll of Fenland and Broadland marks; Additional MS. 23732 containing four distinct Broadland rolls; the Wentworth Roll; the Emeris Roll; the Cantley Roll; the Society of Antiquaries Roll; the Capel Roll; the two Evans-Lombe Rolls; the Blofeld Roll and the Elsing Roll. The last is a fragment only, and on the Capel Roll only one mark is named, while of the Wentworth and Cantley Rolls I have only seen modern copies. That of the Wentworth Roll, by Dawson Turner, is contained in his extended copy of Blomefield in the British Museum. Of the Cantley Roll I have seen three first-hand (and several secondhand) copies and the best of these, which I have followed, is undoubtedly the one belonging to Col. H. H. Gilbert, to whom I am indebted for the loan of it. To the Society of Antiquaries and to the other private owners, the Rev. W. C. Emeris, Major E. H. Evans-Lombe, Mrs. Blofeld, and Mrs. Thackeray I also wish to express my indebtedness for the kindness with which they granted me every facility for studying the rolls in their several posession.

This paper is not intended to contain a complete record of all the marks and owners contained in the above-mentioned rolls, but I have tried to bring together as far as possible all those belonging to eastern Norfolk. Those marks which clearly belonged to owners resident in Suffolk have been omitted; as also have a number, with one or two exceptions, belonging to owners whose identity I have not succeeded in establishing with a reasonable degree of certainty. The distinct marks thus omitted for this last reason number about thirty, but an unknown proportion of them probably belonged to Suffolk owners. Exigencies of space also forbid the record of a number of variations of individual marks, which, as will appear later on, had their significance.

In making the selection here given it has been necessary, besides noting the names of the owners of marks that are absolutely identical, to sort and compare just on 600 that differed sufficiently from one another as to warrant a separate drawing being made of each.

Owing to its geographical features Norfolk occupies in respect of swan-history a peculiar position. Its water drainage

falls mainly into two systems, those of the east and west sides of the county. On the east the rivers Yare, Wensum, and Bure, with their tributaries, drain the great area of the Broads and much of the central area of the county, and uniting with the Waveney, which drains most of the southern border of the county and the adjacent parts of Suffolk, enter the sea through Breydon. In former times this area, which I have elected to call shortly the Broadland area, was supervised as to swan-keeping by the deputy swan-master known as the Master of the Swans for Norfolk and Suffolk and the post was held in 1576 by Edward (afterwards, Sir Edward) Clere of Blickling and in 1625 by Sir Henry Hobart.

The western side of the county drains (at the present time) by the Ouse and its branches, the Nar, Wissey, Little Ouse, Lark, etc., into the Wash at King's Lynn and includes the district of Marshland, lying to the west of the present course of the Ouse, much of which in mediæval times was undrained fen, as of course was a great deal of the area west of a line from King's Lynn to Thetford. This whole area was in fact merely part of the great level of the Fens, stretching from Lincoln nearly to Cambridge and from Peterborough to Thetford and drained to a great extent in common with it. The office of supervisor of the keeping of swans was exercised throughout tihs area by one officer, who was known as the Master of the Swans for the counties of Cambridge, Huntingdon, Northampton, and Lincoln.

Strictly speaking the supervision of swans in this western part of Norfolk should have presumably been vested in the Swan-Master for Norfolk and Suffolk. But the evidence of the rolls of swan-marks points to its having been exercised, at any rate in practice, by the holder of the Fenland appointment, as indeed one would expect from considerations of convenience in working.

The above-defined areas include the whole of the common water areas of Norfolk upon which swans were kept.

The Broadland area being self-contained and almost completely isolated from any other swan-carrying area presents some interesting differences in methods of usage and working from those of western Norfolk, which naturally agree with those of the larger area of which it was a part.

In the first place the right of tenure of a swan-mark, which of course includes the right to keep swans, appears in many instances to have been different in the Broadland area from what it was elsewhere. Throughout England the ownership of swans and a swan-mark was a personal possession, descending from father to son, and could be passed on by the marriage of a widow or heiress, by will, or by deed of gift or sale. In the Broadland area in numerous cases the right appertained to the manor and was not alienated apart from it. In such cases we find the ownership of the mark almost invariably entered on the rolls under the name of the manor, and if a personal name is given at all, it occurs as a secondary heading only. Blomefield mentions such examples where he refers (*Hist. of Norwich*, p. 672) to the manor of Rokels in Trowse "with Blake's swan-mark thereto belonging," and when he says of Carrow Priory (p. 866) "to the scite of this Abby as it is now commonly called belongs a Swan-Mark and Free-Fishery in the River." Stevenson (*B. of Norf.* III., p. 107) mentions a third when he remarks "a small piece of land at Surlingham, part of 'Nash's estate,' now in the possession of Mr. Robert Pratt, has, by ancient custom a swan-right and mark attached." In the case of the ancient religious foundations, both here and elsewhere, there was frequently a mark used by the house itself, as well as one used by the abbot or prior at its head. But here the possession of the mark may have been vested in the whole body of the community and need not have been an appendage of the soil as in the case of the manorial marks. The only other analogous tenures I have come across elsewhere are two in Sussex, where the Bishops of Chichester acquired swan-rights on the river Arun in right of their ownership of the Castle of Amberley, while the Goring family enjoyed a similar privilege in right of their ownership of the Priory of Hardham. There are also a few cases that may be of the same kind, where the mark belonged to a church or parsonage, as for instance the parsonage of Surfleet in Lincolnshire. In most of these, however, I am inclined to think that the right was acquired through the will of some pious testator, as was actually the fact in the case of the church of Sutton St. James (*Lincoln Wills*, II., p. 26).

With regard to the age of these manorial marks, they seem to have originated at various dates. Some are apparently

only of early seventeenth century date, while others undoubtedly go back a very long way and are probably amongst the oldest that have come down to us.

Passing to the marks themselves, the outstanding feature of the Broadland marks as a whole is their simplicity. The great majority consist of various numbers and combinations of triangular, or semicircular, notches (" gaps ") in the margins of the upper mandible, plain bars, chevrons, sloping lines across the bill, and annulets (" oilet holes "). Anything more complex is uncommon, and the elaborate, centrally situated designs, that reach their acme in some of the Fenland marks, are scarcely found at all. Nos. 63 (Mannington Hall), 145 (John Hacon) and 187 (Sir Christopher Calthrop) are practically the only ones that tend to the elaborateness of Fenland marks, while Nos. 144 (Henry Hawe) and 178 (Capt. John Anguish) are actually Fenland marks that came to be used in Broadland at a later date. In the case of 144 particularly it will be noticed how it stands out conspicuously from its surrounding neighbours. On the other hand the simple marks that are so characteristic of Broadland are quite rare on the Thames, while in the Fens they account for barely two per cent. of the total number of marks.

It seems probable that in some of these simple marks we have surviving examples of the earliest swan-marks, whose origin was merely an extension of use to swans of the family marks already in existence for marking the domestic stock. If this be the case these marks must go back to the earliest days of swan-keeping, though the evidence available does not enable us to trace any of them further back than to the middle of the fifteenth, and perhaps to the middle of the fourteenth, centuries.

In their method of record also the marks of this area have their characteristics. It *may* be only accidental, but I have not yet heard of a book of Broadland marks, they are all rolls, whereas elsewhere the true vellum roll is unusual, most are books. The only Broadland marks I know of that are recorded in a book are those to be found in Additional MS. 4977 in the British Museum, but the greater part of its contents belong to the Fenland.

In their method of representation the drawings generally include a great part of the swan's head besides the bill;

elsewhere anything more than the bill is rare. The head may be drawn either in plan (looked at from above) or in profile, both are about equally common. Profile rolls elsewhere are quite rare. The bill is always drawn in plan, so as to display the whole of the mark. This is a point about which the one or two writers who have previously referred to it have been quite hazy. Its non-recognition led to the erroneous representations of the marks of the Bishop and Corporation of Norwich in Yarrell's *British Birds* (IV. p. 339). The position of the nail at the end of the bill, or of the knob at the base, or both, invariably show that the bill is really drawn in plan. The bill is nearly always coloured red, and in some rolls the head is shaded, or the feathering indicated, in grey paint or by pen strokes; there are very few coloured rolls known from other parts of England.

There is a single instance of a lower mandible mark from the Broadland area (No. 187 *infra*), otherwise there is no evidence of this method of marking being used. Lower mandible marks were quite numerous in the Fenland in the latter part of the fifteenth and early sixteenth centuries and a few survived into the seventeenth, but, with the single exception referred to above, do not appear to have been used elsewhere. Leg and foot marks were also fairly frequently used in the Fenland, as well as in many other parts of England, but there is no evidence of their use in Broadland.

The order in which the marks occur on the different rolls is very variable. Most begin with the royal marks followed by those of the spiritual and temporal peers, and this is the case on most Broadland rolls. On many rolls of other areas the marks of religious foundations then follow, succeeded by those of commoners in alphabetical order, but this seems never to have been the case on Broadland rolls. It has occurred to me from time to time that perhaps a territorial classification had been used, but, with the exception of one or two short segments here and there, I have never been able to establish this, and one can only say at present that with Broadland rolls it is not clear that the marks have been entered in any particular order.

For convenience in cataloguing the marks themselves some method of grouping is essential, so I have followed the rolls

to some extent in taking the royal marks first, then those of the religious foundations ; these will be followed by the large group of manorial marks in alphabetical order, and then those of the private owners arranged so far as is possible in groups of periods from the earliest to the most recent.

Of royal marks, six were in use at different times or in different localities ; there is very little evidence to guide one as to which of these qualifications is correct. One I have omitted as it is only given (with others) on a single roll and so was probably only in use for a limited period or in a very restricted area. I imagine that No. 1 is the oldest, and the one most frequently used, as it appears on nearly all the rolls, even where other royal marks are given. It was in use on the Thames also, and certainly before 1500, while it was still used there late in the seventeenth century. Nos. 2 and 3 each occur on two rolls and are probably of early Stuart date. No. 4 is taken from a roll dated 1649 (but no doubt copied from an older roll and possibly elaborated by the artist) where it is given as one of the King's marks ; a more simply drawn variant on an older roll is given for the Queen, so it is probably of Elizabethan date. No. 5 was originally an old royal mark used on the Thames and seems to have been introduced into Broadland for marking the swans belonging to Henrietta Maria the Queen of Charles I. Nos. 1 and 5 are two of the very few instances of an owner having swans in two different parts of England using the same mark in both places (*cf.* Lord Morley, 127 *infra*).

6. The Bishop of Norwich.—No personal names are ever given with this mark, so that it is hardly possible to say how ancient it may be. Unlikely though it may seem with such a simple mark, one scarcely finds it drawn in exactly the same way on any two rolls, and there are at least eleven variants of it that would be easily distinguishable on the living swan. One cannot but wonder at the ingenuity displayed in devising them. The one chosen for reproduction here is probably the oldest and almost certainly of pre-reformation date. Now between 1501 and 1632 there were thirteen Bishops of Norwich and it seems extremely probable that these variations in the mark were brought about by the custom of "differencing" to which I have already called attention in an

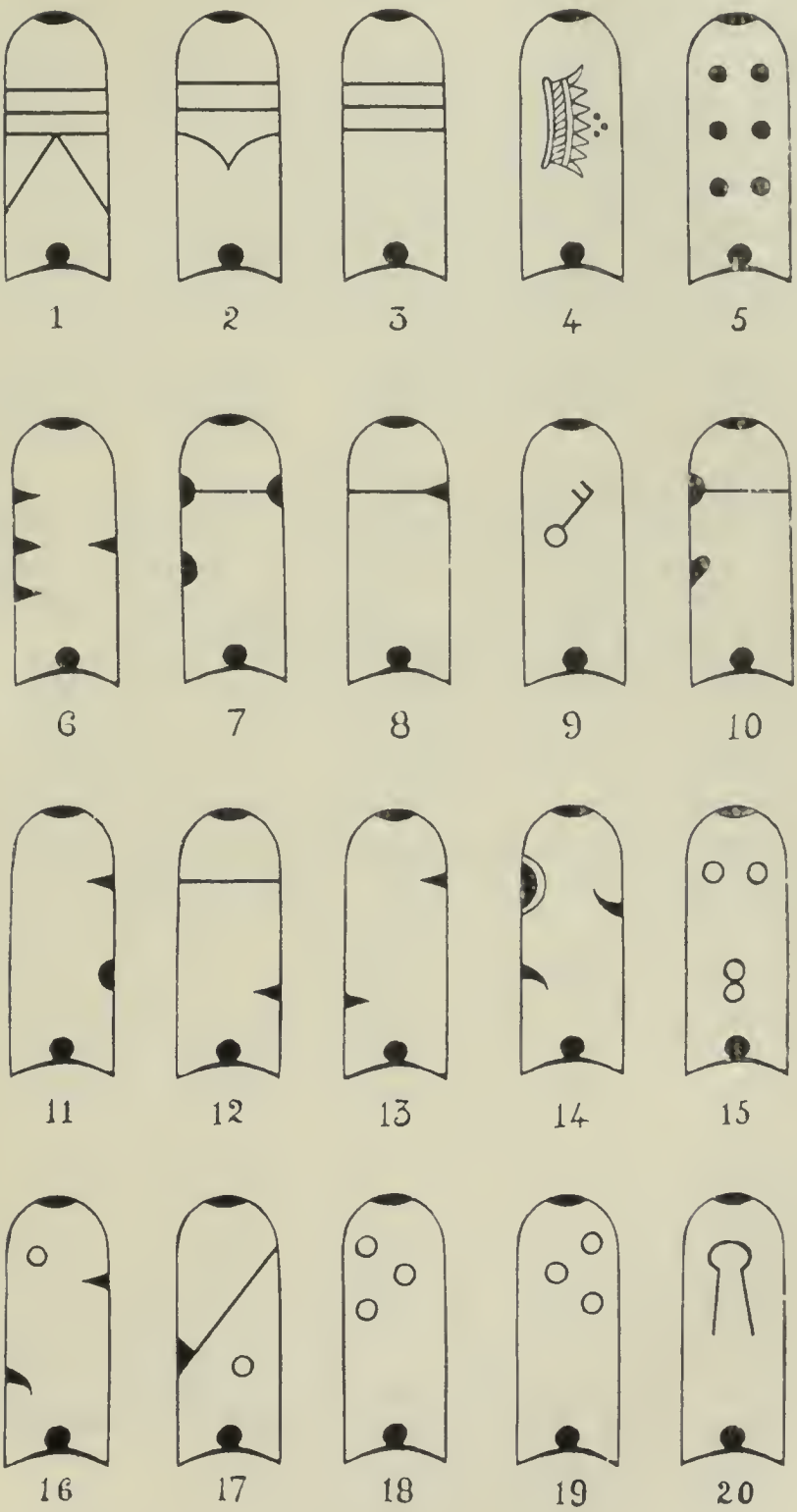

FIGURE 1

earlier paper (*British Birds*, XIX. p. 303), by which each successive owner made some small alteration in the mark, without destroying what may be called its specific character, whereby the swans bred under his particular ownership might be picked out. Yarrell's figure of this mark (*British Birds*, IV. p. 339, No. 10) is entirely wrong. It was evidently taken from a profile roll and the artist had not recognized that in these the bill is always drawn in plan to show the whole mark. Consequently, thinking that only half the mark was shown, he has doubled it in his reproduction. The same mistake has been made with the adjoining mark (No. 9) which is given as that of the Corporation of Norwich. It is not to be wondered at that Stevenson (*B. of N.* III., p. 105) was "unable to match it with any mark on local rolls."

The following marks of the religious houses and their officers are of course of pre-reformation date, but there is no evidence of the date of their origin. There cannot be much doubt, however, that they are amongst the earliest we have.

7, 8. The Prior of Norwich.—No. 8 is the one most frequently given on the rolls and is the one designated by Blomefield "the Prior's new mark." No. 7 is the one he calls "the Prior's old mark." Blomefield appears to have derived his information from a roll, or rolls, in his own possession, which, if they still exist, have not come to light since his day, so that we cannot tell exactly what he means. There are, however, at least five other variants of the mark, so that I am pretty sure that here again we have instances of "differencing" by successive Priors, and Blomefield's description, though correct in a sense, is apt to mislead. One of the Evans-Lombe rolls is the only one that contains a mark for the Dean of Norwich and the mark given is No. 8. The swan-herd was one of the regular lay members of the Priory.

9, 10. The Convent of Christchurch, i.e., Conventus, the whole community. Blomefield (*H. of Norwich*, p. 155) remarks that "the Cathedral though it is dedicated to the Holy Trinity began about this time [1546] to be named Christchurch, by which name it is commonly called." No. 10 is pretty certainly only another variant of 7 and 8.

11. The Prior of Christchurch.

12. The Prioress of Carrow.—As an instance of the

careless copying one so often meets with on swan-rolls, and perhaps of ignorance of fact, this mark occurs on nearly every roll as that of the PRIOR of Carrow. Here again five different variants are found.

13, 14, 15, 16. THE HOSPITAL OF NORWICH, i.e., the Great Hospital, or Hospital of St. Giles. No. 13 seems to be the oldest one and is no doubt of pre-reformation date ; it was, according to Blomefield, afterwards the Mayor's and is given as such in the modern roll in the Castle Museum. No. 14 is the one designated by Blomefield, the Hospital's new mark, by which I suppose he means the one granted to it after its re-founding by Edward VI in 1547. Of the use of Nos. 15 and 16 I can gain no information. None of these four are in use by the Hospital at the present day.

17. THE PRIOR OF BROMHOLM.—The Blofeld Roll, as already pointed out by Mr. Minet (*P.S.A.* Ser. II, XX.) is a terrible example, as to its names, of ignorant copying. The writer was evidently quite at sea with the script of a former generation and has transformed this name into the " Prior of Bromerton." This error forms a good example of the difficulties of making an accurate interpretation of a single roll, without comparing it with others ; for Mr. Minet has not unnaturally taken the scribe to have meant Bramerton and in this has unfortunately been followed by Mr. Gurney (*Early Annals of Ornithology*, p. 112). As a matter of fact there never was a priory at Bramerton ! There are at least eight variants of this mark, which, if my interpretation of them be correct, must carry it back a long way into the fifteenth or even into the fourteenth century.

18. THE CONVENT OF ST. BENETS. 19. THE ABBOT OF ST. BENETS.—There is considerable confusion in the drawing of these marks in different rolls. I have adopted here the one that I believe to be the oldest and therefore the most probably correct. They are clearly complementary to one another. In some rolls No. 18 is given as the mark of the Cellarer, but there can be no doubt that it properly belonged to the *conventus*, or whole community.

20. THE CELLARER OF ST. BENETS.

21, 22. THE PRIOR OF YARMOUTH.—In 1649 No. 21 belonged to " Gostlin," perhaps that William who was an

alderman of Norwich and treasurer of the corn-stock of the City in 1641. No. 22 was vested in the Prior in right of his holding Baynard's Manor in Thurlton. It was afterwards owned by "Mr. Rede of London." William Read, citizen and mercer of London, bought the manor in 1540 and his son William owned it in 1553.

23. The Convent of Langley.

24, 25, 26. The Abbot of Langley.—Of these three marks No. 24 is never given for any other owner; No. 25 had been one of the marks of Sir James Hobart of Hales Hall (d. 1507) and after the dissolution it was one of those of the Dukes of Norfolk. No. 26 similarly passed to the Heveninghams of Ketteringham and appears on every roll over the name of either Sir John (d. 1536), Sir Arthur (d. 1630) or Sir John (d. 1633) right up to Commonwealth times, when it was owned by William, who was one of the regicides.

27. The Prior of Ingham.—In most rolls this name is written "Hyngham," which is apt to lead to error, as it did in Mr. Minet's paper on the Blofeld Roll. There was of course no priory at Hingham and the Trinitarian house at Ingham is the one intended. The mark used by the Townsends of Rainham in the seventeenth century is indistinguishable from this one and it was used by Lord Walpole in the eighteenth.

We now leave the religious houses proper and pass to marks connected with parishes.

28. Our Lady's Light of Acle.—29. Our Lady's Light of Billockby.—30. Our Lady's Light of Caister.—31. Our Lady's Light of Hickling.—These four marks form an interesting and unique group, as there is nothing comparable to them anywhere else. One or more of them are given on every roll and they probably all originated as bequests by will to the respective churches. The object no doubt was that the annual profit of the swans was to be devoted to the upkeep of the lights before the image of the Virgin. The churches were no doubt deprived of these swan-rights at the reformation, for by the statute 1 Ed. VI., cap. XIV. (1547) all annual rents, etc., assigned to sustain any Light, Lamp or Candle in any Church were given to the King. There is no evidence as to what became of them except in the case of No. 29, which was afterwards owned by Edmund Ducke of Hemsby.

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FIGURE 2

In the modern roll in the Castle Museum a mark indistinguishable from it is given for John Harvey of Thorpe Lodge (1755-1842).

32, 33. The Vicar of Martham.—34. The Vicar of Ruston.—35. The Vicar of Caister.—36. The Rector of Stokesby.—37. The Parson of Reedham.—Since no personal names are ever attached to these, the swan-rights represented by them were presumably vested in the livings and not in the individual incumbents. I do not regard it as quite certain, however, as examples of both tenures are to be found amongst Fenland marks and one, which was certainly a personal possession, is frequently catalogued in the same way as these. Those of them that appertained to the living may also have been derived, like the preceeding four, from charitable bequests. It is almost impossible to put any date to them, but I am inclined to believe that Nos. 32, 34, 35, and 36 are pre-reformation, while Nos. 33 and 37 are of later date. Each is only found on a single roll, which in the case of No. 37 is of late seventeenth century date. No. 35 was quite possibly the mark "late Robert Coteler, Clerk," thus described in 1481 in the will of Margaret Paston, and which was one of the two that she bequeathed to her grandson Robert. Robert Coteler was Vicar of Caister St. Edmund 1453 to 1465 and of Mautby 1465-1480.

38. Stalham Church.—This mark is also probably an instance of a charitable bequest, that was doubtless taken away at the reformation; but by whom it was subsequently used there is no information. There are half-a-dozen similar tenures in the Fenland.

39. Stalham Guild.—There were two guilds in Stalham, the one dedicated to St. Mary, the other to St. John the Baptist, but there is no evidence as to which of the two this belonged. They both ceased to exist at the dissolution. The mark had previously belonged to the family of Abbes of Buxton and was no doubt left to the guild by one of them, who had been a member. No christian name is given, so that it is impossible to suggest which one gave it. In the seventeenth century it belonged to the Wards of Horstead, but how far back their ownership extended one cannot say. Guild marks are distinctly rare, only about four or five others (from the Fenland) being known.

40. Magdalen College, Oxford.—I take this mark here, as it is an early one and does not fit into any of the groups that I have adopted. This college owned Reedham Hall in Boyton from 1479 and also property in Hickling that carried swan-rights with it. Blomefield (Ed. II., vol. XI. p. 308) states, " In the 18th of Edward IV. [1478-9] Magdalen College in Oxford had a patent for land called Essex's [in Hickling], the liberty of a swan-mark, granted by William Barforth and Andrew Riches, in Hickling to Thomas Woodhouse of Waxham in the 2nd of Edward VI " [1548-9].

The next group of marks is composed of those already referred to as being attached to the different manors. It seems best to take them in alphabetical order. An attempt at a territorial grouping has not proved satisfactory, and grouping by age is hardly possible, for though many are no doubt of considerable antiquity, it is only with one or two, here and there, that one finds any evidence on the point. In naming the owners of the manors, as probable owners of the marks I have confined myself chiefly to those of the sixteenth and seventeenth centuries.

41. Aldeby Hall.—The manor belonged to the Prior of Norwich and was transferred at the dissolution to the Dean and Chapter.

42. The Manor of Bacons in Ludham.—The manor was sold by the Calthorpes in 1539 to John Corbet of Sprowston, who exchanged it with Rugge, Bishop of Norwich, in 1545 for Wood Bastwick.

43. Beeston Hall.—The personal name given with this is Hobart. The manor came to this family about 1538 through the marriage of Thomas Hobart of Plumstead with Audrey, the daughter and heir of William Hare of Beeston. On another roll the mark is given for Sir Miles Hobart their son, who was alive in 1595.

44. Blickling Hall.—The successive families owning this mark would be the Bullens, the Cleres and the Hobarts.

45. Billockby Hall.—The manor belonged to the Godsalves, the Noons, the Hobarts, and the Mayhews.

46. Brome Hall.—The only owner given for this is Sir William Cooke, who was made a Baronet in 1663 and died in 1708.

47. The Manor of Buckenham Ferry.—The only personal names given under this are Godsalve and Thomas Godsalve. Thomas senior died in 1544 and Thomas his grandson in 1587. Both owned the manor.

48. The Manor of Burgh St. Margarets.—The mark was used by Sir Arthur Capel from 1588 to 1632.

49. Caister Hall.—This mark goes back at least as far as Sir John Paston, who succeeded his father John in 1466 and died in 1479; but the name most frequently associated with it is that of Sir William, either he who died in 1554 or the later one who died in 1610. In a late seventeenth century roll the owner is given as Sir John Pettous, but I suspect that this is a copyist's error for Paston. There is evidence of a considerable amount of "differencing" by successive owners.

50. The Manor of Catts Hall.—Presumably the manor of that name in Hevingham. The name occurs only on a single seventeenth century roll. A mark indistinguishable from this is given on earlier rolls for Stodefeld, presumably the family of Stotevile of Somerton, of whom John was living in 1459 and his son William died in 1495. A later owner was Robert Amys, whom I have failed to identify.

51. Claxton Hall.—The only name given as the owner is Gawdy, which family owned the manor from 1566 till about 1674. Successive owners "differenced" the mark by the addition of one, or two, gaps in various positions. A mark indistinguishable from that here drawn is given on several rolls for Frenfield, or Fornfeld, but of his family I can learn nothing.

52. Dilham Hall.—This title only occurs for this mark in a seventeenth century roll. The mark is probably a variant, instituted by the Bozuns or the Windhams, the later owners of the manor, of the mark of Henry Inglose (*cf.* No. 104) the earlier owner.

Exactly the same "differencing," but in the reverse order, is found in the mark used by the Lords Scales, in connection with their manor of Overhall in Hickling up to 1483, and which passed with that manor to Sir William Tindall, as one of the heirs of Elizabeth, Lady Scales. As given on the rolls the mark of Lord Scales is indistinguishable from that here drawn

for Dilham Hall, while the Tindall's is indistinguishable from Henry Inglose's (No. 104).

53. Ditchingham Hall.—The only owner given for this is Phillip Bedingfield. Besides one who died in 1543 there were three successive generations of this name at Ditchingham in the seventeenth century.

54. Elsing Hall.—This is presumably the mark referred to in Hamon Le Strange's letter of June 1625 to Sir Henry Hobart (*Trans. N. and N. Nat. Soc.*, VIII., p. 175) as anciently appertaining to the lords of Elsing and Gressenhall and at that time being used by Sir Anthony Browne. No personal name is given with it on the rolls. It is of interest from the fact that the lozenge is one of the rarest devices in use as part of a swan-mark.

55. The Manor of Fakenham.—The owner's name added to this is Richard Gwyn, who succeeded to Fakenham on the death of his father (who bought the manor in 1613) in 1629.

56. Gillingham Hall.—The earliest owner given with this is Henry Everard and then his great-great-grandson Edward, who succeeded to it in 1558. It afterwards passed to the Bacons about 1612 and was used by Sir Edmund, 2nd Bart., who died in 1684.

57. The Manor of Halvergate.—The only owner given with this is the Earl of Surrey, a title that was created in 1483 and dormant from 1547 to 1603. In the modern roll in the Castle Museum the mark is given as one of those of the Duke of Norfolk, who would be the natural successor.

58. The Manor of Hassingham.—Blomefield gives no owners for this manor after 1496.

59. Hempstead Hall.—The manor passed from Sir Miles Stapleton of Ingham to the Calthorpes and was sold by them in 1572 to Sir Robert Woods of Norwich, in whose family it remained until 1746. The successive owners of Hempstead appear to have "differenced" the mark by varying the lengths of the gaps and the directions in which they point.

A mark indistinguishable from this is given in one roll for Robert Morse, whom I have failed to identify.

60. Herringby Hall.—The manor was owned by the Cleres of Stokesby.

61. Irstead Hall.—Gurney is the only owner's name

given with this. The family owned the manor from about 1507 till at least 1641.

62. The Manor of Knapton.—The manor was held by the Earls of Oxford to 1613 and by Thomas Blofeld in 1619 (*cf.* No. 164).

63. Mannington Hall.—The name Lomner is also given with this. The family owned the manor from about 1400 to 1585, but the mark was in use before their time, so it must have belonged to the Fewells at the end of the fourteenth century.

64, 65. Martham Hall.—Though these two marks are always given under this one name, it is fairly certain that they belonged to two different manors. No. 64 has the name Brooke added to it on two rolls, so that it is certain that it belonged to Cobham College Manor, which was granted by the Crown in 1585 to George Brooke for twenty-one years. Both manors belonged originally to the Prior of Norwich, and Martham Hall proper, to which no doubt No. 65 belonged, was granted at the dissolution to Hugh Ellis, who was succeeded by Sir Edward Clere.

66. The Manor of Maynards in Martham.—Though clearly thus named on several rolls, this manor is not to be found in Blomefield, who however mentions a manor called "Meys."

67, 68. Mautby Hall.—Originally owned by the Mautbys, the manor passed to the Pastons by the marriage of the Mautby heiress Margaret to John Paston about 1445.

69. Melton Hall.—The only owner given with this is Edward Anguish who was living in 1677, though the family acquired the manor in 1609.

70. Moulton Hall.—The only personal name given with this is Anguish, which family owned the manor from about 1602 to the beginning of the eighteenth century, but the mark is certainly older than this.

71. Oby Hall.—Blomefield (Ed. II., vol., XI. p. 175) writes:—"John Clipesby, Esq., son of Edmund, on a division of the Caly's inheritance, enjoyed this manor in the 9th of Henry V. [1422-23] and let to farm 126 acres of land and the manor house, except the chambers on the east side of the hall, with the solary above, and the chapel adjoining, with

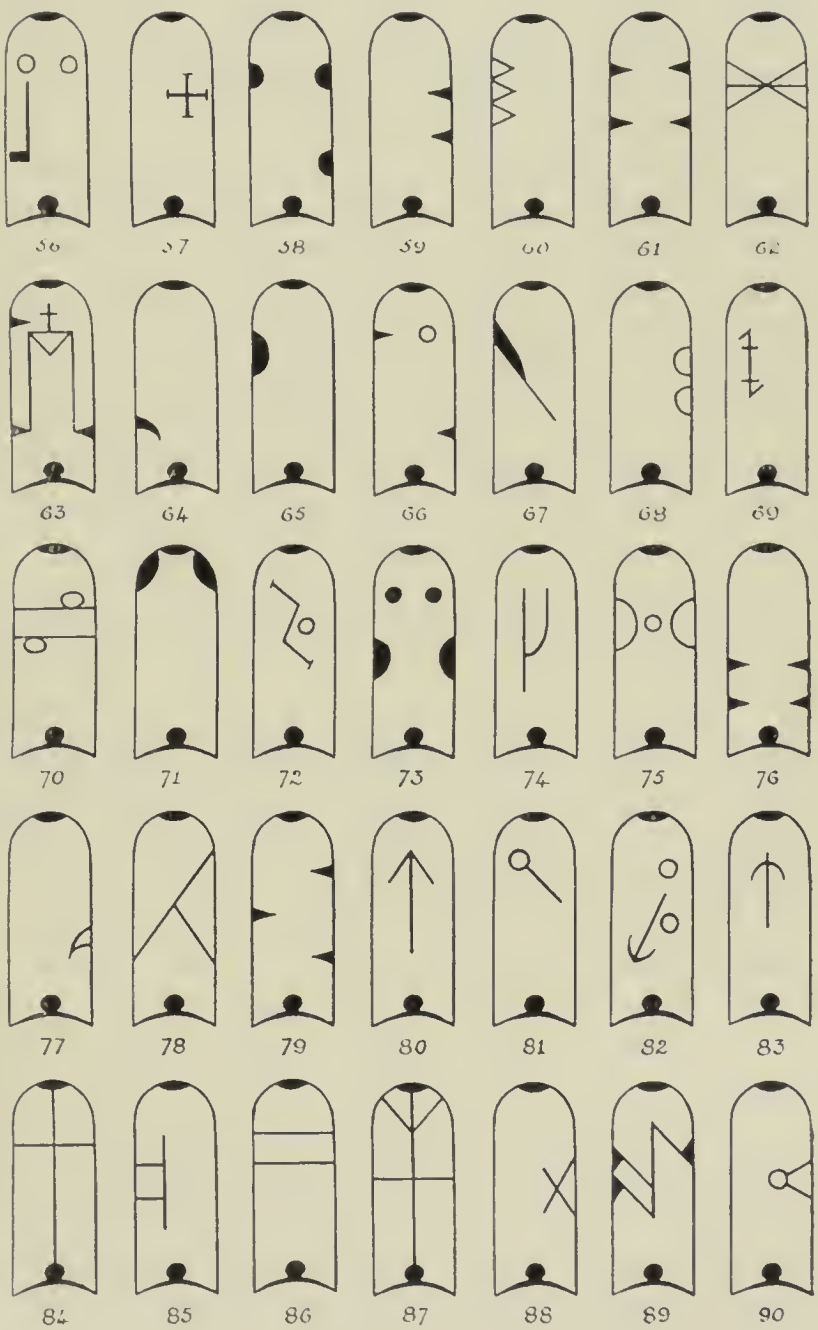
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FIGURE 3

the stable, and free ingress and egress, perquisites of court, wards, etc., and swan-mark at 20l. *per ann.* This John died in 1454" [having married Eve, one of the daughters and co-heirs of Sir William Caly, who died in 1380]. This mark therefore goes back well into the fourteenth century. The Clipesbys held the manor till about 1595 and were succeeded by the Guybons of Lynn, who used a totally different mark, not distinguishable from that of Claxton Hall (No. 51).

72. Rackheath Hall.—The successive owners given for this mark are :—(A) Yelverton, of whom William is the only definite one mentioned. The family owned the manor from the time of Edward III. and the first William was the Judge, who died in 1472. There were three generations after him at Rackheath, two being also named William.

(B). Helmes.—On the death of William Yelverton in 1518 the manor and swan-mark passed to his sister Anne, who had married James Helmes. They belonged to his family till 1590, when they were sold by his grandson William to

(C). Thomas Pettous, Mayor of Norwich in that year. The mark is given on a later roll for his descendant Sir Thomas, who died in 1654.

(D). William Dixe. On one roll the mark is assigned to "William Yelverton, modo William Dixe." The latter was a wealthy merchant of London, who purchased Wickmere about 1570, and was a trustee for the Duke of Norfolk's possessions in the county, dying in 1591. He had a grandson, also named William, but it is difficult to see how either of them acquired any interest in this mark.

"Differencing" seems to have been effected by reversing the mark, a method not infrequently adopted in the case of asymmetrical designs.

73. Ranworth Hall.—This mark is always associated with the Holdich family, but no christian names are ever given. In one of the early nineteenth century copies of the Cantley Roll the name Kerrison has been added as a secondary title, this presumably refers to Thomas A. Kerrison, who was Mayor of Norwich in 1806 or to Roger, who was high sheriff in 1800 and died in 1808.

74. Ravens Hall.—I can find nothing about this manor. It appears to have been situated somewhere between Langley

and Burgh Castle (*Blickling MSS.*, Hist. : MSS. Com. p. 62). The mark is only given on one roll, but is quite a distinct one.

75. Rokels Manor in Trowse.—This mark is always given on the rolls for Blake of Trowse, but, as the following from Blomefield (Ed. II., V., p. 459) shows, it was actually a manorial mark and in use before Blake's time :—" Rokels manor in Trowse was conveyed in 1438 by Robert Howlyn, clerk, to Sir John Clifton, Kt., John Windham, Esq., and Will Gladine of Norwich, notary publick, with all the fisheries, swan-marks, etc., and in 1445 they released it to Clifton. In 1491 it belonged to John Blake," who died that year. In 1532 it belonged to St. Giles' Hospital and in the modern roll in the Castle Museum it is given as " Rockels Manor, late the Hospital, now the Mayors."

76. Smallburgh Hall.—The manor was successively in the families of Calthorpe, Parker, Cornwallis, and le Gross.

77, 78. Stalham Hall.—No. 77 is the only one that has an owner's name attached, viz. : Sir John Clere, who succeeded his father at Ormesby in 1529 and died in 1557. Blomefield does not mention the Cleres as having any interest in Stalham, which belonged to the Stapletons, the Calthorpes, and the Woodhouses.

79. Stockton Hall.—This mark goes back to Sir Thomas Erpingham (d. 1428) and was later owned by the Calthorpes. Neither family are mentioned by Blomefield as owners of the manor, which was in the hands of the crown for a long period in the sixteenth century, so one must conclude that this was adopted as the Stockton Hall mark after their ownership ceased.

A mark only distinguishable from this by the spacing of the gaps on the right side, which are closer together, is given on several rolls for Halle, a family which it is not possible to identify ; on the Blofeld roll that family is given as their successors. It is not possible to say which member of the family first owned the mark, but by the date of the roll it must have been prior to their ownership of Hoveton. In the lists of Norfolk M.P's. Thomas Blofeld, who was Mayor of Norwich in 1691 and several times M.P. between 1688 and 1702 is described as of Norwich up to 1691 and as of Hoveton in 1695. In the first half of the seventeenth century they

owned manors in Beeston and Knapton. On the modern roll in the Castle Museum this mark appears as one of those of the Corporation of Norwich.

80. Stokesby Hall.—The family of Clere is generally given as a secondary heading, the owners named being Edmund, who died in 1487 and Sir Thomas, his grandson. The manor belonged to the family from about 1400 to about 1640.

81. Sutton Hall.—This mark is found drawn in three different ways ; as here shown, sloping in the opposite direction and straight up and down the bill. In one or two instances the circle is drawn incomplete, so as to form a hook. These are again probably instances of "differencing." On two rolls it is given as the mark of Lord Abergavenny, who were owners of the manor from 1436 onwards. The Elizabethan holders would have been Henry Nevill, 4th Baron 1536-1586, Edward, 5th Baron 1586-1589, and Edward, 6th Baron 1589-1622.

A mark indistinguishable from that here drawn is given on two rolls for Henry Palmer ; he was of Moulton and died in 1523.

82. The Manor of Thurton.—The manor belonged to the Abbey of Langley and was granted to Thomas Godsalve after the dissolution.

83. Toft Hall.—The manor was granted by Edward IV. to Kings College, Cambridge.

84. Tunstall Hall.—The only owner given with this is Richard Jenkinson, who was sheriff of Norfolk in 1600 and 1616.

A similar mark, but with a semi-circular gap at the left end of the cross-bar, is given on a late seventeenth century roll for Walters of Reedham.

85. South Walsham Hall.—The Earl of Surrey (probably of the revived title, see 57 *supra* and 172 *infra*) is the only owner given for this.

86. Waxham Hall.—The manor belonged to the families of Stapleton, Calthorpe and Woodhouse successively.

87. The Manor of Whitwell.—Giles Simons is given as the only owner. He died between 1588 and 1597, but his father Ralph, who died in 1557, also owned the manor.

A mark indistinguishable from this is given on several rolls for Hansard, but it is possible that this was the Suffolk family and the mark was used by them in a different district.

88. Witchingham Hall.—The only family given is Barney, of whom several generations were owners of Cley Hall and Street Hall in Witchingham prior to 1598.

A mark indistinguishable from this one is given for Coppledyke, of which Lincolnshire family two younger branches were settled during the sixteenth and early seventeenth centuries at Kirby Cane and Hethersett, and intermarried. Their swans would no doubt have been kept on waters a long way from Witchingham and so no confusion would be likely to arise.

89. The Manor of Woodbastwick.—The only personal name given with this is Corbet. John Corbet of Sprowston obtained the manor by exchange from the Bishop of Norwich in 1545 and it remained in his family till 1660, but the mark certainly belonged at one time to an earlier owner, who would have been the Abbot of Langley. A mark indistinguishable from it was used in the Fenland by Ovstowe Priory, Leicestershire.

90. Yelverton Hall.—The manor was held from 1322, as Rackheath, by the families of Yelverton and Helmes, from whom it passed to Humphry Rant who died in 1609. It was held by his descendants to the middle of the eighteenth century.

We next come to the personal marks of private owners, and will begin with a group of considerable interest in that it is composed of those whose use can be traced, if not with certainty in every case, with a considerable degree of probability well back into the fifteenth century and in one or two cases into the middle of the fourteenth. Apart from the marks of the religious foundations, whose antiquity we have very little means of gauging, these, with some of the manorial marks, are undoubtedly some of the oldest that have come down to us.

91, 92. Bacons Calthorp.—Both these marks are thus headed in the rolls. By analogy of similar entries this should mean, formerly Bacon's now Calthorp's. It seems clear, therefore, that the marks must have descended from the one family to the other by the marriage of Sir Oliver Calthorpe with Isabel the daughter of Sir Robert Bacon. She was the heir of her brother, Sir Bartholomew Bacon of Ludham, who was presumably the earlier owner of the mark, and died in 1391. Sir Oliver Calthorpe died about 1399. No. 91 is given on a late seventeenth century roll, "differenced" with a roundel,

centrally placed near the tip of the bill, for one of the Pettous family. No. 92 had several later owners, Brian Stapleton (*vide* 95), John Topy, Sir John Clere (*vide* 142) and Sir Edward Clere (*vide* 111).

93. Sir Thomas Erpingham, of Erpingham and Blickling, 1357-1428.

94. This mark occurs with the legend "St. Bennets ex antiquo Cardeston," which seems to mean that it anciently belonged to the Kerdistons of Reepham and afterwards to the Abbey of St. Benets. Sir William Kerdiston died in 1391 and Sir Thomas, his grandson and the last of his line in 1446.

95. Sir Brian Stapleton.—96. Sir Miles Stapleton.—These two marks are thus named in the rolls, but they were both without doubt contemporaneously held by Sir Brian Stapleton of Ingham, for in his will dated 1438 he gave to Miles his son, "all his household stuff, etc. at Ingham, with all his swans and cygnets of the new and old mark" (Blomefield, IX. p. 321). Sir Miles the son died in 1466. What afterwards became of No. 95 does not appear, but No. 96 passed, with Ingham, to the Calthorpes by the marriage of Elizabeth, the daughter of Sir Miles, with Sir William Calthorpe and we find it given on several rolls as owned by Sir Francis (d. 1543) their son.

97. Nicholas Castle, of Raveningham, Sheriff of Norfolk in 1433.

98. Robert Norwich.—This mark occurs under this name on every roll and undoubtedly is of considerable antiquity. There seem to have been two, or possibly three, individuals of this name who might be the one intended, but the most likely I think is Robert Norwich of North Tuddenham, who died in 1440 and is buried in the Cathedral. The mark is even to be found under the name Norwich on the modern roll in the Castle Museum, where it is also repeated as a mark for the Hospital.

99. Jenney Boys, thus entered on the roll. It is evidently a similar heading to Nos. 91 and 92 and would read in full Jenney, formerly Boys. Sir Edmund Jenney of Knotishall, Suffolk, married Catherine, the daughter and heir of Robert Boys of Little Plumstead, Crostwick and Honing, who died in 1449, and thereby became the owner of the mark.

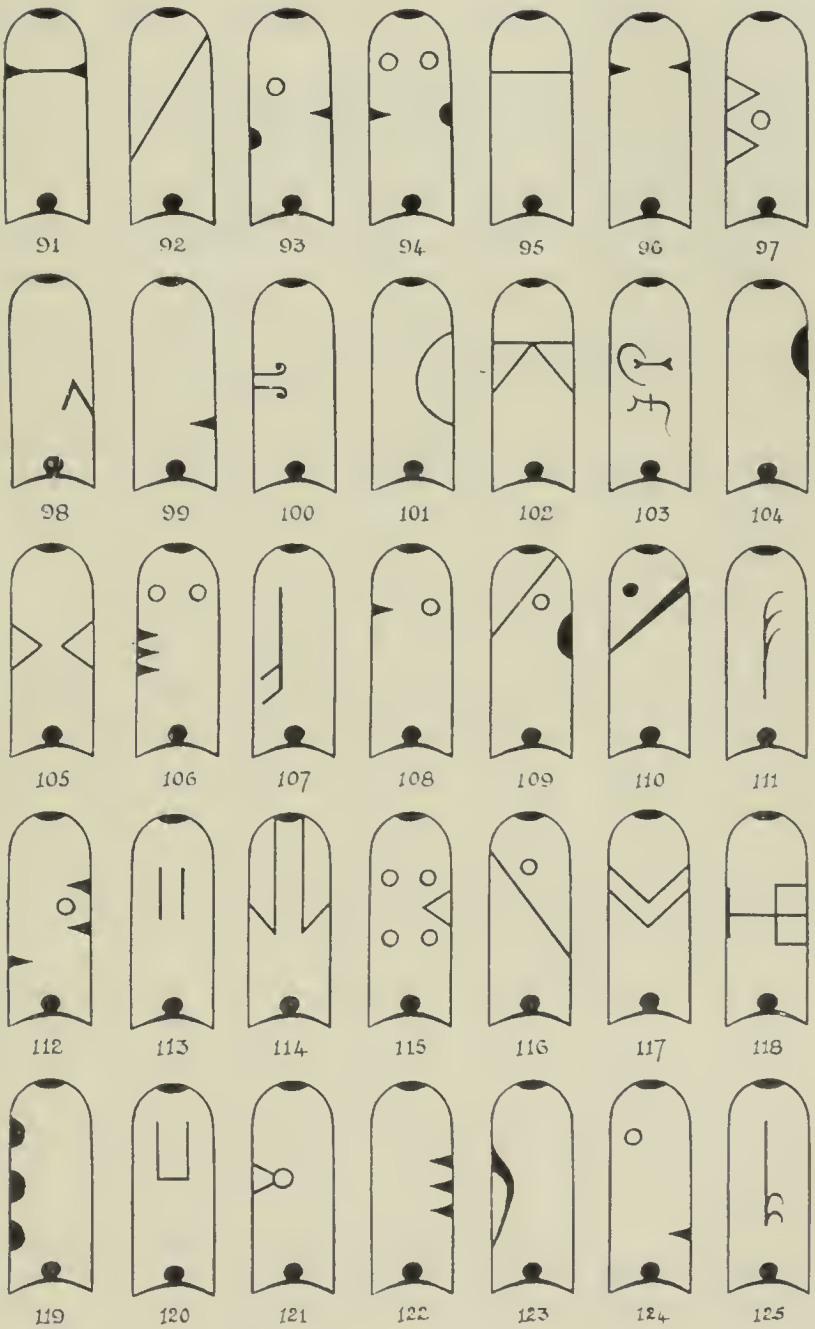
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FIGURE 4

100. Thomas Fenn.—A Thomas Fenn sold Latimers Hall in Bacton in 1428 and the same man (or another) was five times Bailiff of Yarmouth between 1432 and 1457. The only other Thomas Fenn I can find was of Norwich and died in 1596, aged 59, but I am certain that the mark is far older than that.

101. Edmund Paston.—The only Edmunds seem to have been (*a*) the younger brother (1425-1446 ?) of John Paston of Paston (1421-1466) and (*b*) the latter's third son, the father of Robert, whose grandmother Margaret (Mautby) left him her swan-marks in 1481.

102. Sir William Yelverton, of Rackheath.—There were two possible owners of this name. The first, the Judge, was knighted in 1461 and died in 1472; the second, his grandson, was married in 1477. The mark was afterwards owned by Augustine Steward of Norwich, who was mayor in 1534 and 1556 and died about 1570, and by Thomas Pettous of Norwich who died in 1597.

103. John Payne, of Nowers Hall, Ittringham. Here again are two possible owners, John who died in 1469 and his great-grandson of the same name. The mark is of interest as being derived from the owners initials; though not infrequent elsewhere, there are only four other instances known from this area (*cf.* No. 167).

104. Henry Inglose of Dilham and Loddon, d. 1516.

105. Robert Inglose of Buckenham Ferry, Holveston in Haverland, Felthorpe and Brandeston, d. 1475. I take these two marks together as it is thus that they occur on most of the rolls. The owners were the two sons of Sir Henry Inglose, who died in 1451 and his manors were divided between them. Though there is no evidence on the point it seems highly probable, I think, that they also inherited his swan-marks.

With regard to No. 104, see remarks under Dilham Hall, No. 52. The same mark was in the late seventeenth century one of those used by Sir Christopher Calthorpe.

106. Hugh Fenn of Stalham and Herringby, founder of Herringby College, living in 1436, died 1476.

107. Edmund Wydwell.—This mark appears to have passed through a succession of well-to-do Yarmouth owners, of whom the present one is the earliest named and was Bailiff

in 1422 and 1426. John Lampett succeeded him (Ralph Lampett was Bailiff four times between 1444 and 1461) and John Lavile, who was Bailiff in 1512, 1521, 1530 and 1543, followed after. Later still it belonged to the Cornwallis family of Brome, Suffolk.

108. Elizabeth Clere.—There are several possible identifications of this owner, but I have no doubt that the correct one is Elizabeth, the daughter and heir of Thomas Udall of Tacolnestone, who married Robert Clere of Ormesby and was left a widow in 1446. She was in possession of all her husband's properties until her death in 1492. A comparison with No. 124, the mark of her son Sir Robert, suggests that this is only his mother's mark, "differenced" by altering the positions of the annulet and gap.

109. John Coke ye Draper, citizen of Norwich, sheriff in 1461 and 1473 and mayor 1484. His mark, name, and description are found on nearly every roll, even to the latest.

110. Osbern Barney, of Bradeston, wounded at the siege of Caister Castle in 1469, died about 1490.

111. John Selotte, D.D., master of St. Giles' Hospital, rector of Winterton 1455, Archdeacon of Sudbury 1462, Chancellor of Norwich, died before 1479.

112. Sir William Calthorpe of Calthorpe and (*jure uxoris*) of Ingham, died 1494. The mark is also given as owned by Sir Phillip, either his son (d. 1535) or his great-grandson, who inherited the paternal estates, as being the elder branch. It will be noted that the Stapleton mark that came into his family by his second marriage was inherited by the younger branch (*vide* No. 96).

113. Phillip Bosard, of Ditchingham, died 1490. This was afterwards used by the Holdich family of Ranworth and was "differenced" by them by the addition of a gap on each side of the bill near the tip, or of a semi-circular gap on each side near the base (*vide* No. 156).

114. Phillip Bosard (*idem*). Also owned later by the Holdich family.

115. Richard Blundevile of Newton Flotman, d. 1490. It was later owned by Robert King of Newton, who married Patience, the daughter and co-heir of Thomas Blundevile, Richard's great-grandson, and "differenced" by him by moving

the gap to the opposite side of the bill. In 1649 it was owned by Francis Wrote of Gunton.

116. Sir Terry Robsart, of Syderstone, d. 1497, the grandfather of Amy Robsart, wife of Robert Dudley, Earl of Leicester.

117. Hullocks.—A number of names are connected with this mark besides this one, Wrampill (or Wramble), Simon and John Ball, and John Ponet. I am confident that the mark goes back to about the end of the fifteenth century and I am inclined to think that it belonged to a succession of Norwich families, though I am not entirely satisfied with the following identifications. A Nicholas Hullocks resided in St. Bartholomew's Parish towards the end of the fifteenth century, a Simon Ball was alive in 1553 and John Ball was an alderman and M.P. for Norwich in 1554. A John Ponet was alive in 1548.

In 1673 the mark was owned by Francis Cory of Bramerton, then Recorder of Norwich, who "differenced" it by the addition of an annulet between the chevrons on the right side and a gap at the left hand end of the basal chevron; one or more of the other "owners differenced" with an annulet between the chevrons on the left side.

118. John Richers of Swannington, d. 1501.

A mark, distinguishable from this one by the presence of two sloping lines from the left edge of the bill to the centre of the transverse bar, is given on two Elizabethan rolls for John Deynes. In one he is described as of Hevingham, in the other as of Lammas. Though I have succeeded in finding several men of this name, none of them answer to either of these descriptions.

119. Sir William Boleyn, of Blickling, knighted 1483, d. 1505, the grandfather of Anne Boleyn.

120. Sir James Hobart, of Hales Hall in Loddon, Attorney General to Henry VII., d. 1507. The mark is also given for his son Sir Walter, who died in 1538, and for his grandson Henry, who died in 1561. The last "differenced" the mark by reversing it.

A mark indistinguishable from this is given on five rolls for Dennis Willis. The only man of this name I can find received a grant of land from the Abbot of Langley in 1443. If this

be he, he must have been an earlier owner than Sir James Hobart. On a late seventeenth century roll the name space over this mark was originally left blank and the name Barker has been written in subsequently in quite a modern hand. Perhaps this may have been John Barker of Shropham, who was sheriff in 1756 and died the same year.

121. William Gurney, of West Barsham. His will is dated 1507.

122. Sir Robert Southwell, of Wood Rising. There were two possible owners of this name, the earliest of whom was knighted in 1503. In any case the mark goes back to his nephew and heir Sir Richard, who was knighted in 1542, while it is also given for Sir Thomas, the last of his line, who died in 1643. He "differenced" the mark by making the gaps semi-circular instead of triangular; three other variants are to be found, but in each case only the surname is given.

123. Sir Robert Clere, of Ormesby, knighted 1494, d. 1529. The mark was afterwards owned by Sir Walter Hobart (d. 1538) and evidently continued in his family, for, though the intermediate links are missing, it ultimately passed to Christopher Reeve (d. 1690), the nephew and heir of Sir Edmund Reeve, who purchased certain of the Hobart possessions from Anthony, Sir Walter's great-great-grandson, in 1631. It was therefore in use for roughly two centuries.

124. Sir Robert Clere (*idem*).—Afterwards also owned by his grandson, Sir Edward Clere of Blickling, who was sheriff in 1580. (*cf.* No. 108).

The next group of private marks, though it probably includes some that are older than we have evidence for, cannot be traced at present beyond the beginning of the sixteenth century and may, to be on the safe side, be called pre-Elizabethan.

125. Thomas Francis (or France), was lessee of the tithes of St. Margarets in Fybridge Gate, Norwich, in 1520.

126. Reinold Littlesprowe, sheriff of Norwich, 1523 and 1532 and still living in 1534.

127. Lord Morley.—There is no evidence as to which holder of the title was the first owner, though it probably goes back to Sir Henry Parker, who was summoned to Parliament in 1523. The title fell into abeyance in 1686 and the mark was afterwards used by Sir Randall Ward of Bixley, Great

Plumstead and Postwick, who succeeded his brother in 1742 and died about 1760. The mark is of interest because it was also used by the Lords Morley for their swans on the Thames, a very unusual circumstance (*cf.* Nos. 1 and 5).

128. William Seyve, d. 1529. I can find but little about this man; he was patron of Mundford and probably died young, as his heir was only ten at the time of his death.

129. Lord Fitzwalter.—130. Lady Fitzwalter.—These two marks occur on all the rolls under these names, and are instances of the persistence with which the names of original owners were copied from one roll to another, regardless of altered circumstances. At the same time it is evidence that the marks were in use by this family before 1530, when Sir Robert Ratcliffe, Lord Fitzwalter, was created Earl of Sussex, a title which the family held until 1641. The barony came to this family by marriage in 1485. The marks as given on different rolls show "differencing" by successive owners.

131. Robert Jermey, of Norwich, who died about 1533. The mark occurs "differenced" in at least five ways and was perhaps thus used by the different branches of the family descended from him. The only clue however occurs with one of them, in which the gaps are made as ordinary triangles. This is given for Jermey of Marlingford, the first of whom was Thomas, the third son of Robert of Antingham, the eldest son of Robert of Norwich.

132. Sir Phillip Calthorpe, of Calthorpe, who died in 1535, or his son of the same name who was knighted in 1546.

133. Sir John Heveningham, of Ketteringham, d. 1536. The mark most frequently given for this owner is the one he obtained from the Abbots of Langley (No. 26).

134. Edmund White, of Shottesham, d. 1538. On the death of his son Edward in 1558 without issue, the mark passed to his daughter Anne, who had married Henry Doyley of Shipdam, and is given on different rolls as the property of their grandson Sir Henry, who died in 1616, or of Sir William, who died in 1677.

135. Leonard Spencer, Town Clerk of Norwich, d. 1540.

136. Gedge of Martham, so given on the rolls, but I have not succeeded in identifying him. The mark certainly belongs to this period, but may be even older.

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FIGURE 5

137, 138. JOHN SPILMAN, of Narborough. There are two possible owners of this name, Sir John, the Judge, who died in 1545 and his grandson, who succeeded him and died in 1581. No. 138 almost certainly belonged to the Judge, but No. 137 may be a later mark.

139, 140. THOMAS CLERE, of Stokesby.—No. 139 is also given for Charles Clere. Sir Thomas, knighted in 1544, was father of Charles, who was father of a second Thomas, sheriff in 1595, died 1619, who was father of a second Charles, who died in 1636. I include these marks here, but there is no certainty that they go back to Sir Thomas, though it is fairly certain that No. 139 goes back to the elder Charles.

141. THOMAS GAWDY of Shottesham and Redenhall, d. 1556. The mark was used in the seventeenth century by the Bayspooles of Haddiscoe, who "differenced" it by the addition of a second annulet.

142. SIR JOHN CLERE, of Ormesby, to which he succeeded in 1529, d. 1557. In the eighteenth century a mark indistinguishable from this one was owned by William Springall; later owners still were Thomas Tuck, who purchased Surlingham in 1815, and died in 1835, and W. J. Owen Holmes, Esq., of Strumpshaw.

143. THOMAS HOLL, of Heigham, *viv.* 1552. Later owners were Dawson, Harris of Yarmouth, and Hexam of Acle. Harris was evidently a well-to-do Yarmouth family, as there was a Thomas who was Bailiff in 1581, a John, Bailiff in 1590, and an Ezekias, Bailiff in 1620 and 1631. Of the others I have not been able to learn anything.

144. HENRY HAWE, of Woodhall and Modneye manors, Hilgay, d. 1592. I include this mark here as it was primarily a Fenland mark used by the same owner and his father James (d. 1552-3) before him, though I have not seen it on a Broadland roll under the father's name. As used in the Fenland it had the two gaps triangular and was "differenced" as here drawn for use on Broadland waters.

145, 146. JOHN HACON.—The marks almost certainly belong to this period, so presumably the owner was that John whose grandson was of Wheatacre and died in 1598.

147. MARTIN SIDLEY, of Morley, which he bought about 1545.

148 Sir Francis Lovell, of East Harling, d. 1550. His great-grandson of the same name, who was knighted in 1603, succeeded in 1604 and died in 1623, was probably also an owner of this mark, which however, certainly goes back to the earlier Sir Francis.

149. Thomas Palmer, of Moulton, d. 1558.

150, 151, 152. The Duke of Norfolk.—Since this title was dormant from 1573 to 1662 and the latter date is later than the majority of the rolls on which the name occurs, it follows that these marks must have been in use before 1573. As a matter of fact they are probably far older, though in respect of 150 and 151 it is impossible to guess at their date of origin. In the case of 152, however, there is the significant entry on one roll, "Dux Norfk, ye Kings," which indicates the forfeiture of the mark to the crown, and must have reference to the attaint either of John the first Duke in 1485, or of Thomas the third Duke in 1546.

153. Roger Stanhowe, of Bedingham, who died about 1569.

154. William Paston, of Caister and Oxnead. He succeeded to Caister in 1540, was knighted in 1578 and died in 1610.

155. Barney of Reedham.—This mark occurs on every roll and generally with the heading here given. The fact that it is found "differenced" in at least eight ways points to it having been used by a long line of successive owners. The only definite one named on the rolls is Sir Richard, who was made a Baronet in 1620 and died in 1668. He was the eighth owner of Reedham after Sir Thomas the first owner, who died in 1389. I include the mark in this group, though it may well belong to the earlier one.

156, 157, 158.—Holdich of Didlington.—159, 160. Holdich of Foulden.—I include these marks here as there is no means of dating them, but since two or more of them are present on every roll they are probably of fairly early date. They always occur, without christian names, with the designations here given, though in a wonderful variety of spelling. The family held property in both places in the time of Edward VI. and remained at Didlington till 1650. Nos. 157 to 160 are probably I think all derivatives of one original

mark, but in the total absence of any christian names it is impossible to trace any succession or to be certain. No. 159 is given on one roll for "Richard Knights, the manor of Lamkins," but I cannot find anything of him or of the manor. No. 156 is of course Bosard (No. 113) "differenced."

161. Leonard Castle, of Raveningham. This mark should really have been included in the earlier group as I find that the only Leonard in the family was the son of Humphrey, who died in 1461. He was succeeded by his grandson John, who died in 1552-3.

The next group of marks we cannot be sure of as being earlier than the time of Elizabeth.

162. Castle of Raveningham.—No christian name is given.

163. Edward Gascoyne, Commissary in the Archdeaconry of Norwich, 1562.

164. The Earl of Oxford.—There is no clue as to which of the Earls first used this mark, but it occurs on two Elizabethan rolls only, so I include it here, though the title goes back (with breaks) to the twelfth century. The individual owners at this time would be John de Vere, 16th Earl 1539-1562 and Edward, 17th Earl 1562-1604. It is very probable I think that this mark is merely a variant of that of the Manor of Knapton (No. 62) which was their property.

165. Robert Rogers, described on the roll as "Lord of ye manor of Brittens." He owned Bretons Manor in Witchingham in 1566 and was living in 1579.

166. Thomas Cecil, of Witchingham St. Faiths, second cousin of Sir William Cecil, Lord Burghley.

167. Edward Linsey, of Gunton and Colby.

168. Bassingbourne Gawdy, of West Harling and Mendham, d. 1590. The mark is also given for his son, Sir Bassingbourne, who was knighted in 1597 and died in 1606, "differenced" by the addition of a gap within the half hoop.

169. Sir Nicholas Le Strange, of Hunstanton. It will be remembered that Mr. Southwell printed, in vol., VIII. (p. 175) of these *Transactions*, a letter dated June, 1625 from Sir Hamon Le Strange to Sir Henry Hobart, applying for the grant of a swan-mark for use on his swans at Gressenhall, and added that the result of the application was not known. It

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FIGURE 6

would be a very simple matter to suggest that the present mark is the one that was granted him, and that it had afterwards descended to his son Sir Nicholas. Unfortunately however Sir Hamon lived until 1654 and his son was not made a Baronet until 1629, both dates being later than that of the roll on which this mark is recorded. Had the mark belonged to Sir Nicholas, his father (d. 1592), it is most improbable that he would not have referred to it in his letter. We must conclude therefore that it belonged to Sir Nicholas, his great-grandfather (d. 1579), and that it fell into disuse or was sold before he was born. He could have had no personal knowledge of his great-grandfather and he was only nine years old at his father's death, so he may easily have never heard of the mark.

170. Martin Sidley, of Barford, which he bought in 1580. The mark is given as one of those of the Corporation of Norwich in the modern roll in the Castle Museum.

171. Sir Drew Drewry, presumably of Riddlesworth, though on the roll he is described as of Catton, knighted 1579, d. 1617. The mark is of particular interest, as the owner has contrived it, from the silver cross tau on the green chief, from his family coat of arms. There are only two similar cases known to me from this area, and they both occur amongst Suffolk owners. They are quite rare anywhere.

The remaining marks, so far as we can tell, were originated during the seventeenth century.

172. Lady Surrey.—Since this mark is only given on a single roll, of early seventeenth century date, it is probable that the owner was Alathea, daughter of Gilbert Talbot, Earl of Shrewsbury, and wife of Thomas Howard, Lord Maltravers, to whom the Earldom of Surrey was restored in 1603.

173. The Countess of Suffolk.—Since this mark is only to be found on two rolls of early and middle seventeenth century date, this lady was most probably the second wife (and widow) of Thomas, Lord Howard de Walden, who was created Earl of Suffolk in 1603. About the same time he received a grant of Mount Surrey, the Duke's House and Surrey House in Norwich. She was Catherine, the daughter and co-heir of Sir Henry Knevett of Charlton, Wilts. and widow of Richard, the son of Lord Rich, and died in 1633. Elizabeth, the wife of Theophilus, the second Earl, pre-deceased her. Posssible

later owners were the two wives of James, the third Earl; Susan, daughter of Henry Earl of Holland, married 1640, died 1649 and Barbara, daughter of Sir Edward Villiers, married 1650, died 1680.

174. Sir — Windham, of Felbrigg.—This mark is found on a single roll only, dated 1649. The owner at that time would have been Thomas (d. 1653) who was not a knight, so perhaps the mark belonged to Sir Roger, whose heir he was. A roll, apparently very similar, though I have not seen it, was executed by the same artist for Sir Charles Windham in 1673 (Stevenson, *B. of N*, III., p. 110).

175. Sir John Hobart, of Blickling, to which he succeeded in 1625, knighted 1611, d. 1647.

176. Lady Hobart.—There are several possible identifications of this lady, but the most probable seems to me to be, Dorothy daughter of Sir Robert Bell and wife of Sir Henry, who died in 1625 and whom she survived for sixteen years. Her father was a swan-owner in the Fenland and her husband was Swan-Master for Norfolk and Suffolk, so that it would be quite probable that she took an interest in swans and that her husband should have made her an owner. On the other hand it is possible that the mark is intended for a monogram F.H., in which case the owner would probably have been Frances, daughter of John Egerton, Earl of Bridgewater and second wife of Sir John (No. 175) whom she survived five years.

177. Sir Henry Jerningham, of Costessey, to which he succeeded in 1619, created a Baronet 1621, d. 1646. In the modern roll in the Castle Museum this mark is given for Lord Stafford his descendant, "differenced" by the removal of the gap from the left tip to the middle of the right edge.

178. Capt. John Anguish, of Great Melton, *viv.* 1635. This mark occurs first on a roll dated 1649. It was primarily used in the Fenland, where it passed through the hands of several owners and can be traced back to the beginning of the sixteenth century at least. The name Anguish first appears in connection with it on Fenland rolls of about 1630. In a Broadland roll of 1674 it is given for "Jac. Wallop of Thorpe by Norwich," who "differenced" it by inverting the central design.

179. Sir Peter Gleane, of Hardwick Hall, knighted 1624. There was an earlier owner, B . . . ., but the rest of the name

is too faded to read. A later owner was "Davy," perhaps Robert Davy of Ditchingham and Norwich, Recorder 1688 and M.P. 1698, 1700 and 1702, d. 1702.

180. Dr. Clere Talbot, LL.D. of Dunston, Commissary in the Norwich Archdeaconry 1620-1660.

181. Thomas Allen, of Street Hall, Witchingham, which he bought about 1600, d. 1650.

182. Francis Neve, of Great Witchingham, d. 1652.

183. Mr. Bacon, Attlebridge Hall.—Francis Bacon, appointed a King's Bench Judge in 1642, and knighted, bought Brockdish Hall, Attlebridge.

184. Mr. Tuttell, Saxlingham.—John Tuttell of Saxlingham died 1684.

185. Sir Robert Yallop, of Bowthorpe, knighted 1664, d. 1705.

186. Sir Nevill Catelyn, of Kirby Hall, Kirby Cane, knighted 1662, d. 1702

187. Sir Christopher Calthorpe, of East Barsham, d. 1718. This mark is unique in this area, as it is the only instance of the use of a gap on the lower mandible. The method of indicating it here adopted is the usual one used in Fenland.

188. Mr. Dee, Lord of the Manor of Thorpe.—Rowland Dee, merchant of London, purchased the manor of Thorpe by Norwich. He was patron of the Church in 1670.

189. Mr. Herne.—From a roll dated 1674 and so presumably Clement Herne of Haveringland, who died in 1694, *æt.* 84, or Henry Herne of Norwich, Sheriff in 1661 and Mayor in 1673.

190. Simon Croshold, of Norwich, *viv.* 1677.

191. Herbert Astley.—Presumably Herbert (d. 1680), son of Dr. Herbert Astley, Dean of Norwich. There was no Herbert in the Melton Constable family.

192. Sir Arthur Furness, of Hingham Hall.

193. Mr. Suckling.—From the 1674 roll and so presumably Robert, of Woodton, who was a Deputy Lieutenant for Norfolk in 1677 and died about 1690.

194. John Cook.—From the 1674 roll. John Coke of Holkham died in 1661. A John Cook was sheriff of Norwich in 1697.

195. Guy Lloyd, "for Bylaugh." This is probably an eighteenth century mark and owner (though I have not traced him), as it occurs only as an extra entry, in a more modern hand, at the end of the 1674 roll.

IV.

SCOLT HEAD ISLAND

By O. D. Kendall and J. A. Steers

Preface

Two years ago, an account of the physiography of Scolt Head Island was published in these Transactions. Since that time further mapping has been carried out, and the beginnings of what we hope may be an annual survey have been made. Most attention has been given to the west end of the Island, since the Outer Point is necessarily an unstable structure, and considerable alterations have taken place in that area. These are described in another part of this paper.

This year an attempt was to be made in making an ecological map of the Island, but this has been postponed for the time being, for various reasons.

It has been pointed out many times that Scolt Head Island affords scope for many workers in different branches of science. There are, for example, few better places for studying the interactions between physiographical and botanical agents. With this in view an attempt has been made to establish a number of permanent levelled marks on the Island from which future levelling may be carried out. It is not an easy matter to measure directly the rate of accretion of salt marshes, but the subject is of great interest to many workers. With the aid of the levelled marks, it is hoped that, by running very careful level lines, at considerable intervals of time, across selected marshes, a direct measurement of the rate of accretion may be made.

Again it is of interest to compare the relative levels of the different marshes. If air photographs, taken at intervals, during a rising spring tide, were made, this would be a comparatively easy matter, as the water line at any one moment could be taken as a contour. This, however, is not practicable, and the lack of high ground on the Island makes ordinary photography, applied to this end, of no avail Hence it seems that levelling must form the basis of such a survey, at any rate for the present. In carrying out such work, it seems useful to obtain not only the levels of the marshes, but also those of the creek bottoms and of the shingle ridges. By

so doing, a relation is established between the newer marshes, or those just beginning to form, and the high and older marshes. On account of the irregular silting in creeks, an exact concurrence of levels is not probable, but some approximation of equality in levels between creek floors in older marshes and the average surface level of newer marshes should result. Further, the height of a particular section of marsh above the creek floors is a rough indication of the amount of accretion.

The carrying out of this work, in detail, however, implies also a study of the growth of vegetation. This year such a study has not been possible in any detail, but now that a series of levelled marks has been established, stereoscopic photo-survey from definite points may aid very greatly in determining the amount of increase in the vegetation of a particular sector, and this, combined with re-levelling may form the basis of important volumetric measurements.

Result of Re-Mapping, 1927

The map of Scolt Head Island was revised in July, 1927.* It has not been considered necessary to reproduce the entire map, though minor points of difference have been noted throughout. The portion westwards from the Long Hills has been redrawn on a scale of 1/2400, and is reproduced along with this paper. This is the part of the Island which is undergoing the more rapid change at the present time. It will be noted that the Outer Point compared with the 1926 map, has moved in position, about 60 yards to the south-west. This ridge has been modified in shape and the bend shown in 1926 is now not so pronounced. Many parts of the ridge have a definite sand covering and a well defined sand shelf has been built on to it on its outer side (see map).

Ridge No. 28 is not so well defined as in 1926 and apparently has been pushed in towards the dune line.

Ridge No. 31 is no longer in evidence, nor is the trough marked U on the map of last year. However, a further spread of shingle (No. 31 on the present map) has now appeared and is separated from the main line of shingle by a depression. This may be the old Ridge No. 31 in a new position.

* On the accompanying map, "Bight" has been substituted for the word "Bite" of the 1926 map, on the advice of Dr. Long.

1. The "Blow-out" near the old Flag Staff

Photo] [*J. A. S.*

2. Formation of new Dune Ridge at west end of Island

BRITISH
MUSEUM
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HISTORY.

BRITISH
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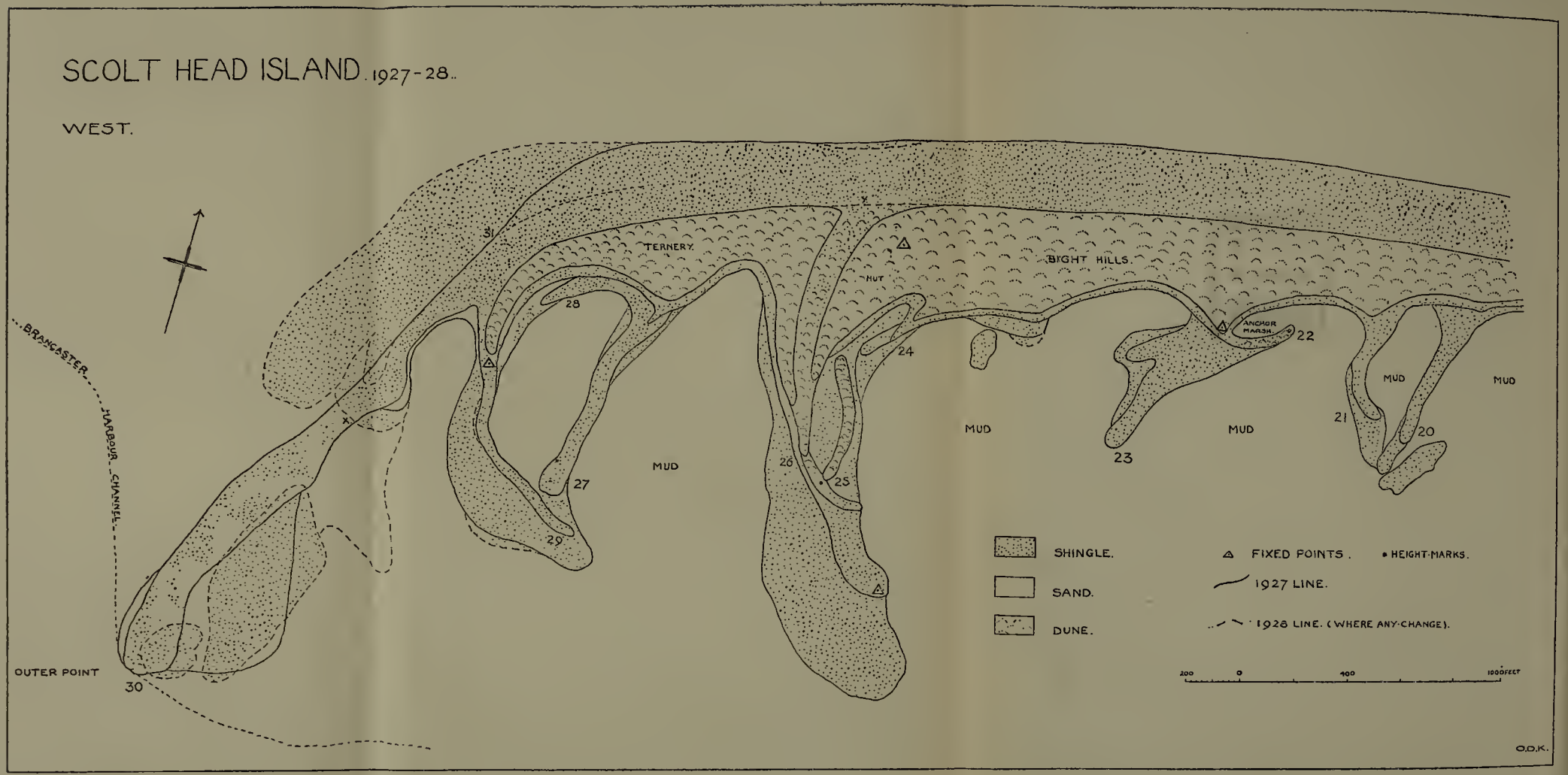

SCOLT HEAD ISLAND. 1927-28.
WEST.
BRANCASTER HARBOUR CHANNEL
OUTER POINT
TERNERY
HUT
BIGHT HILLS.
ANCHOR MARSH
MUD
MUD
MUD
MUD
31
28
27
29
30
26
25
24
23
22
21
20
SHINGLE.
SAND.
DUNE.
FIXED POINTS.
HEIGHT-MARKS.
1927 LINE.
1928 LINE. (WHERE ANY CHANGE).
200
0
400
1000 FEET
O.D.K.

The Brancaster Harbour Channel has again been swung round to westward. It is indicated by a line of dashes, and its representation is only approximate.

Small differences have been noted on other parts of the Island and mapped. These will be shown when the next general map of the island is considered necessary.

It is difficult to give measurements of the heights of the shingle ridges. That of Ridge No. 29, taken near the extreme end of the dunes, is approximately 3 feet, and that of Outer Point No. 30, 14 feet 9 inches. An attempt has been made, wherever possible, to outline the ridges apart from the full spread of shingle.

The field work for the map was carried out by plane table, and four points have been fixed by means of substantial stakes. Their position is shown on the map. These points should prove of great assistance in the future and at least three of them are not likely to be disturbed or covered up.

The contoured map has been compiled from field work carried out this year (1927). This work was completed by plane table and Indian clinometer. Further details of this map are given in another section of this paper.

Result of Re-Mapping, 1928.—West End of Island

The results of the mapping of July, 1927, and July, 1928, have been reproduced on one sheet which accompanies this account.

There have been remarkable changes in the Outer Point area since 1927. Evidence of these is seen at the west end of the Ternery. Ridge 29 remains much the same, but the spread of shingle to the north is much more extensive. Outer Point (Ridge 30) has been completely cut off and almost demolished. It will be remembered that in July, 1927, at its extremity, this ridge had a height of almost 15 feet. There is now little to distinguish it from the surrounding shingle and sand. It appears that the new position of Outer Point will be established for some time, in the neighbourhood of Point X on the map. The enlarged spread of shingle at Point X as shown on the map may provide the necessary material for the new ridge, which is not at all well defined at the present time.

Other changes are comparatively insignificant. Notice that at Point Y the dune line has become more clearly defined, and the gap of previous years is now not so pronounced. The dunes have built up here.

Three of the four points established in 1927 were identified and re-occupied, but the fourth had apparently been washed away or covered up. It might be noted that the Bird Watcher's hut has been rebuilt and moved a few yards in position, as compared with the 1926 map.

Note on Contoured Map of the Hut Hills

This map has been compiled from field work carried out in the Summer of 1927 by Mr. M. D. Bushell. It includes the major group of sand hills on the island. The map was made directly on to a plane table, and the contours were put in with an Indian pattern clinometer. A point just under the hut was chosen as a datum height of 0 feet. It corresponds approximately with the normal high water mark.

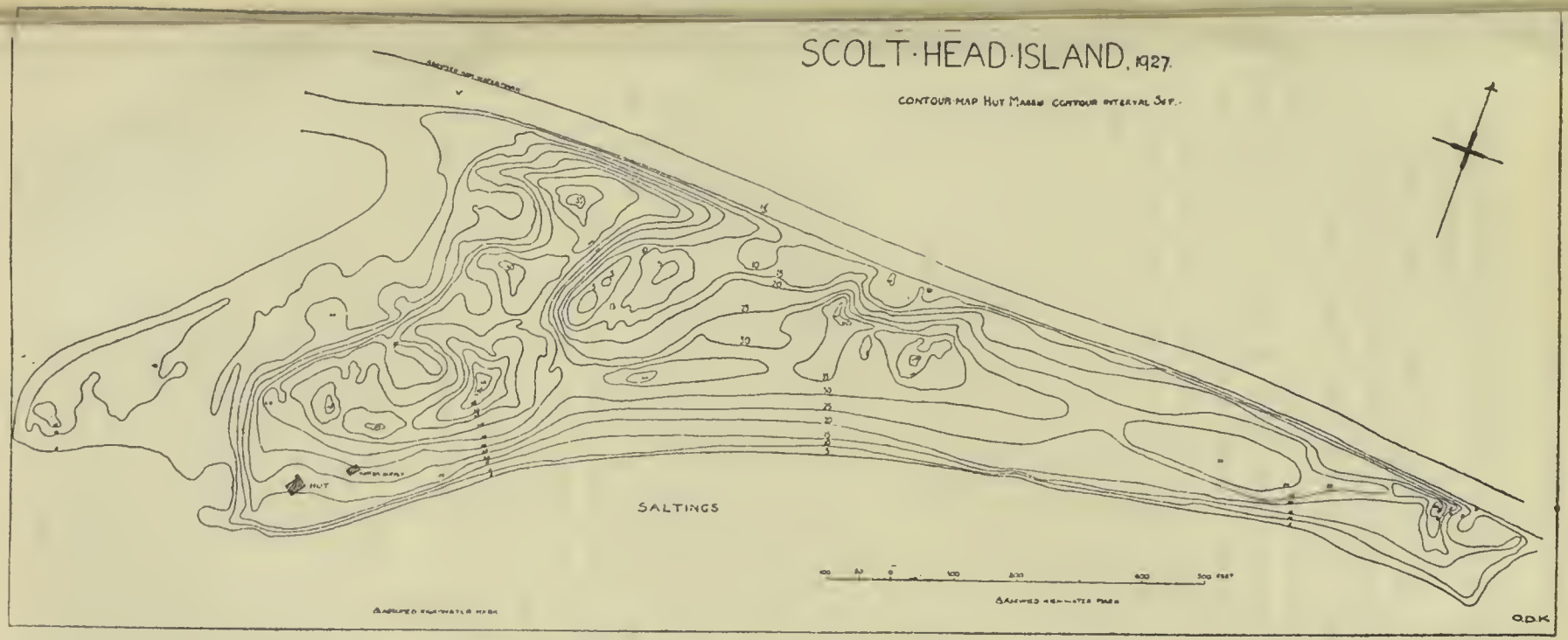
The large scale of the map, and the closeness (five feet vertical interval) of the contours serve to bring out the main features of the hills very well. The "blow-outs" are very clearly shown, especially those facing north-east and also that one on the Flagstaff Hill (point 63 on the map). The steepness of the hills on the sea and marsh sides is well shown. Direct wave attack on the sea side and sapping by waves during very high tides on the marsh side have been responsible for much loss of recent years. The wind, too, has carried away much sand from the unprotected parts, which includes those reached by the water on both sides.

Levelling, 1928

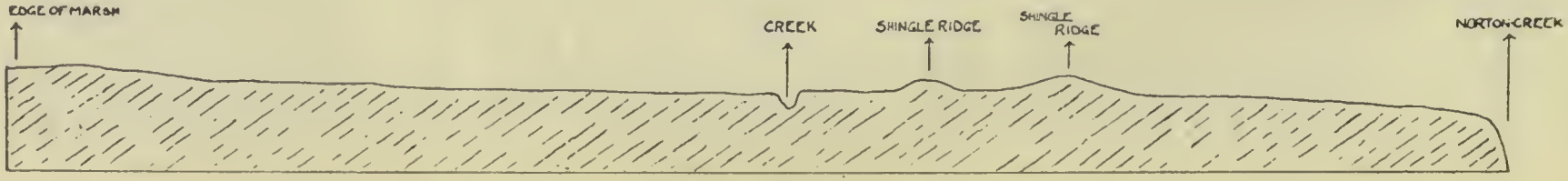
A general account of the objects of the levelling has been given in the earlier part of the paper. It now remains to speak of the work actually carried out. In some ways this was disappointing, since on several of the days spent on the island the wind was blowing half a gale, and also actual field work disclosed modifications and improvements, which must of necessity wait until next year.

Objects were :

1. To run a line of levels along the length of the island.



Contour Map of Hut Massif. Contour interval 5 ft.



Section.—350 yds. east of Level H.T. below Hut. Main Dune Line, Norton Creek.
Horizontal Scale, 1 inch to 300 feet. Vertical Scale, 1 inch to 15 feet.

2. To connect the levelling to the nearest bench mark on the mainland.
3. To fix as many definite level marks as possible.
4. To attempt lines of levelling across selected marshes.

A temporary mark was established near the junctions of ridges 18 and 19. From this point lines were run along the Long Hills to Creek R, and then westward via Anchor Marsh and Ridge 25 to Ridge 29 where the level height was marked on the stake which was established in 1927. Although the lines of levels was continued to the old position of Outer Point, the results in this sector are not noted, as all this area is now under water at high tide. To the east the line was run from the temporary mark to a point below the Hut and via Smugglers' Gap to the Burnham end of the Island.

The temporary mark was later tied in to a permanent mark obtained when the line of levels was transferred from the mainland.

In all ten level marks were fixed. They are all wooden stakes (about 2 inches in cross section) and from one foot to a foot and a half of the stake shows above the ground. The actual height of the position is shown by a mark scored across the width of the stake. Extra precautions were taken with the main point at the junction of Ridges 18 and 19. This stake was firmly fixed in a bed of concrete, some feet below the surface. In other respects it is similar to all the other marks.

There were several difficulties in the way of carrying a line of levels over from the mainland, such as varying states of the tide and numerous soft muddy places en route.

A trial run from Brancaster Staithe to Ridge 19 showed how they could be overcome.

The nearest B.M. shown on the 6 inch map could not be traced. It transpired later that it has been definitely lost. On the Jolly Sailors Inn however, a comparatively new B.M. was discovered. Brigadier Jack, Director General of the Ordnance Survey very kindly supplied the following information regarding this. " The height of the new Bench Mark on the ' Jolly Sailors ' is 28.402 feet (Newlyn Datum) or approximately 29.839 feet referred to the now obsolete Liverpool datum. No new edition has yet been published of the 6 inch Norfolk Quarter Sheet 2 S.W. This area is not being revised at

present, but the new levels will appear on the next reprint which will probably be issued in about 2 years time."

The actual surface heights and height of marks with some description of their positions is given below.

HEIGHTS OF PERMANENT MARKS ABOVE GROUND

End of Dunes Ridge 29	1.41 feet
End of Dunes Ridge 25	1.06 ,,
Anchor Marsh Point (22)	1.09 ,,
Near Creek R. (mouth)	1.52 ,,
Temp. Mark. End of Long Hills	2.57 ,,
Concrete Mark (End of Dunes Ridge 19) ...	0.63 ,,
End of Ridge 16	1.30 ,,
S.W. of Hut	1.22 ,,
Smugglers' Gap (West End)	1.39 ,,
B.M. "Jolly Sailors"	1.35 ,,
Pt. Midway Smugglers' Gap and Burnham End	0.76 ,,
Burnham End of Island	1.19 ,,

DISTANCES OF LEVEL LINES

Temp. Mark Long Hills to Creek R and Ridge 25	5453 feet
Ridge 25 to Outer Point	3153 ,,
Temp. Mark, Long Hills to Hut S.W.	3110 ,,
Hut S.W. to Smugglers' Gap	2548 ,,
Temp. Mark to Concrete Mark and "Jolly Sailors"	6662.5 ,,
Smugglers' Gap to Burnham End	11125 ,,
Sections Hut Marshes	10538 ,,
Total : 8 miles plus	

HEIGHTS OF PERMANENT LEVEL MARKS—(Surface Level)

"Jolly Sailors" B.M.	27.052 feet
Perm. Concrete Mark, Beach Point	16.742 ,,
Temp. Mark. End of Long Hills	17.352 ,,
Near Creek R. (Mouth)	18.112 ,,
Anchor Marsh (Ridge 22)	18.092 ,,
End of Ridge 25	18.012 ,,
End of Ridge 29	15.762 ,,
End of Ridge 16	16.162 ,,
S.W. of Hut	16.167 ,,
Smugglers' Gap	13.887 ,,
Midway Smugglers' Gap and Burnham End ...	14.647 ,,
Burnham End of Island	15.727 ,,

DESCRIPTION OF POSITIONS OF PERMANENT LEVEL MARKS

Concrete Mark. Beach Point. Ridge 19. At beginning of Dunes.
Creek R. South end of Creek. Near end of Dunes.
Anchor Marsh. End of Ridge 22. Summit.
Ridge 25. End of Vegetation.
Ridge 29. End of Dunes, on Trig. Point.
Ridge 16. Summit. End of Vegetation.
S.W. of Hut. Edge of Marsh.
Smugglers' Gap. Edge of Marsh.
Midway Hut and Burnham End. Edge of Marsh.
Burnham End. End of Dune line. South side.

The instrument used was a Cooke, Troughton and Simms Improved Engineers' Level. Stadia Lines enabled the staff distances to be calculated.

It was not possible for various reasons to carry out level lines across selected marshes to the extent required. Five lines were run across the Hut marshes and two others across the marshes between Anchor Marsh Point and Ridge 20. An example of the result is shown on a sketch accompanying this paper. It will not be possible to correlate results and draw conclusions until much more extensive work has been carried out. The section reproduced does not include all the creeks crossed. Only representative ones were noted.

V.

METEOROLOGICAL NOTES, 1927

(*From observations taken at Norwich*)

BY ARTHUR W. PRESTON, F.R.MET.SOC.

JANUARY

THIS was the fifth January in succession with a mean temperature above the average. There was only one night with frost in the screen during the first half of the month, but between the 16th and 23rd it was colder, with some snow on the 21st and 22nd, which, however, was at no time more than half an inch deep on the level. The last week was very

stormy, with a violent gale on the night of the 28th. This storm was of almost unprecedented violence in Scotland, gusts of 102 miles an hour having been recorded near Glasgow.

FEBRUARY

From the 3rd to the 20th the whole country was enveloped more or less with an extensive anti-cyclone resulting in much fog, particularly on the 11th, 12th, and 13th. By day the temperature was generally low during this period, but fairly high during the latter part of the month. Sunshine was 27 hours deficient, and there were 15 days during the month on which the sun was either altogether obscured or shone for less than an hour.

MARCH

Much mildness prevailed during the month, and there was no snow, and no frost in the screen. On each day, 19th to 22nd inclusive, the thermometer reached or exceeded 60 deg., reaching 65.5 deg. on the 21st. The first three days were very windy, as were also the 23rd and 31st, but on many days light south-westerly winds prevailed. Vegetation at the end of the month was forward for the season, but less so than in the previous year.

APRIL

The most notable feature was the very fine weather which prevailed during the Easter holidays (15th-19th) as well as on the three following days, the shade temperature exceeding 60 deg. on six successive days, and reaching 69 deg. on the 19th, and 68 deg. on the 21st. The last week was very cold for the time of year, with morning frosts daily. On the night of the 29th-30th the thermometer fell to 29.4 deg. in the screen and 24.7 deg. on the grass. There was considerable rain during the first fortnight, but little afterwards, the month's total (1.55 ins.) being 0.16 ins. deficient.

MAY

The month entered with one of the sharpest May frosts on record, probably since 1877, the thermometer falling to 28.5 deg. in the screen, and to 23 deg. on the grass here, and to 21 deg. on the Ipswich Road. This frost following on

those at the close of April did an immense amount of damage, nearly destroying the pear crop, and killing much of the early vegetation. In particular, laburnums in exposed situations lost all their bloom. Fortunately the apples were hardly forward enough to suffer much, but great havoc was done in exposed parts of the county. Although rain fell on twelve days the falls were very light, and by the end of the month the drought was much felt, the total rainfall having been 0.63 ins. only.

JUNE

With the advent of June commenced the long period of torrential rains for which the year 1927 will long be remembered. The drought complained of at the end of May broke up on June 1st and at first the rains which followed were very welcome, as much as 1.60 ins. falling in the first eight days. From the 17th to 30th rain fell almost daily, heavily at times, and the month's total was 4.80 ins., constituting the wettest June here since 1860. Heavy thunderstorms occurred at times, particularly on the 7th, 23rd, 24th, and 28th. There were but few warm days during the month, and sunshine was 13.6 hours deficient.

JULY

The rainy weather which characterised June continued during the early part of July, culminating in a heavy downpour, accompanied by thunder, on the night of the 6th, when 1.41 ins. was gauged. Although the weather continued unsettled until the last week there was much less rain after the ninth day, but there was a great absence of summer heat and sunshine. The highest reading of the thermometer was 79 deg. on the 5th, and the month's sunshine was as much as 60 hours deficient. The last week of the month was finer, with some moderately warm days, and as the nights generally were not cold the month's mean temperature (61 deg.) nearly approached the normal. The hay harvest was, however, much impeded, and the absence of sunshine much retarded the ripening of the corn.

AUGUST

Although the rains here fell very far short in quantity compared with those of other places in various parts of England (5 ins. in Surrey and 8 ins. at Harrogate) the total here (3.35

ins.) was an inch above the average. The month opened with a disastrous Bank Holiday during which 0.65 ins. of rain fell, and between the 5th and 21st rain fell almost daily. The last week was fine, but there was no great heat during the month, the thermometer failing to reach 80 deg. on any day. Thunder occurred on the 6th, 10th, 12th, 23rd, and 25th, and there was a gale on the 22nd. Harvest operations were much hindered by the frequency of the rains in the middle of the month.

SEPTEMBER

After the first week the rain returned with redoubled vehemence, culminating with tremendous downpours on the 13th (0.86 ins.), 14th (2.11 ins.), and 15th (1.94 ins.), reminding one of the Norwich flood rains of August, 1912, and resulting in the month's total of 7.15 ins., which is a record here for September. A month's fall of 7 inches or over in this neighbourhood is very rare, records back to 1865 showing only the following previous instances, November, 1878, 7.92 ins.; October, 1892, 7.62 ins.; August, 1912, 11.27 ins.; and July, 1922, 7.33 ins. Winds were chiefly from a westerly point, and were strong and gusty at times, reaching gale force on the 21st and 24th, and sunshine was 37 hours deficient.

OCTOBER

A ten days' respite from the unsettled weather so long prevalent, and which was destined to recur, coincided with the advent of an anti-cyclone on October 3rd, accompanied by an abundance of sunshine, although morning fogs were not infrequent. Slight showers and lower temperature followed, but it was not until the 21st day that the cyclonic storms from the Atlantic again became prevalent with high winds and considerable rains. Down to the 21st day the month's rainfall was less than half-an-inch, but over two inches fell during the last ten days. On the night of the 28th-29th, a very violent and destructive gale from the south-east and south prevailed all over the kingdom, stripping many trees of their leaves. Much mildness prevailed during the last week, keeping the gardens gay for the time of the year, the screened thermometer not once falling below 32 deg. There was a short thunderstorm on the afternoon of the 31st.

NOVEMBER

This was the wettest November in this neighbourhood since 1878, the large total of 5.17 ins. of rain having been gauged here. The month was also remarkable for the unusual warmth which prevailed during the first week, when the high maxima of 61 deg., 65 deg., and 61 deg. respectively were observed on the 1st, 2nd, and 3rd. The reading of 65 deg. was a record for November. On the night of the 3rd the unusually high minimum of 56.4 deg. was also recorded. The latter part of the month was much colder, but there was practically no frost, a great prevalence of overcast skies keeping the nights warm although the days were cold. There were many exceedingly gloomy, dismal days, and hardly any sunshine after the middle of the month, with much fog at times. A thunderstorm occurred in the early morning of the 11th.

DECEMBER

Much sunless weather prevailed during the first fortnight, with no frost and much cloud. On the 16th a severe winterly period set in with snow and sharp frosts, the thermometer falling as low as 19.4 deg. in the screen on the 16th, 20.7 deg. on the 18th, 14.2 deg. on the 19th, 23.2 deg. on the 20th, and 24.2 deg. on the 21st, with ground readings on those days of 12 deg., 15.7 deg., 9.0 deg., 16.2 deg., and 18.3 deg. respectively. On the 21st a deep depression from the Atlantic brought a rapid rise of temperature, which however again fell to low levels in the last week. On Christmas Day, after a rainy morning, snow fell all the afternoon and night to the depth of 8 inches on the level, but drifted to great depths in parts of the country exposed to a furious north-easterly gale which then prevailed. The snow when melted yielded 1.18 in. of water. A remarkable rise of the barometer occurred between the 23rd and 28th, the mercury rising from 28.60 ins. on the former day to 30.60 ins. on the latter, these readings having been respectively the lowest and highest for the entire year.

The Seasons

Tables of mean temperature and rainfall of the four seasons of 1927 (including December, 1926, but excluding December,

1927) and compared with those of the five previous years and with the average.

TEMPERATURE

Seasons	1922	1923	1924	1925	1926	1927	Average for 30 years.	Departure of 1927 from average
	degrees	degrees	degrees	degrees	degrees	degrees	degrees	de ees
Winter -	40·2	41·3	37·3	41·6	39·7	39·4	38·4	+ 1·0
Spring -	46·9	47·3	46·7	47·6	48·5	48·6	46·7	+ 0·9
Summer -	57·9	60·3	60·2	61·5	60·6	59·7	60·2	—0·5
Autumn -	48·4	47·8	51·2	48·2	50·3	49·9	50·1	—0·2
Year - Jan. to Dec.	48·3	48·7	49·4	49·2	50·0	49·1	48·8	+ 0·3

RAINFALL

Seasons	1922	1923	1924	1925	1926	1927	Average for 35 years.	Departure of 1927 from average
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Winter -	9·86	8·07	7·40	6·06	7·26	5·64	6·21	− 0·57
Spring -	5·32	3·95	6·58	6·31	4·70	4·23	5·55	—1·32
Summer -	10·54	6·45	6·08	4·65	6·92	10·62	6·89	+ 3·73
Autumn -	6·06	8·84	10·86	8·51	7·01	14·92	7·83	+ 7·09
Year - Jan. to Dec.	32·49	27·74	30·77	25·10	24·66	36·90	26·48	+ 10·42

The winter was 1 deg. above the average temperature, the spring about 2 deg. above, but the summer and autumn rather below normal. The winter's rainfall was about half an inch deficient; the spring, owing to the very dry May, 1.32 ins. below normal. The summer yielded an excess of rain 3.73 ins. above the average and was the heaviest here experienced in any summer since 1912 (when the total was 17.25 in.) although in 1922 the total nearly approached that of 1927. The greatest excess of rain occurred in the autumn when the total nearly doubled the average, and the yield was the greatest in any autumn on the monthly Norwich records which extend back to 1865.

The Year

1927 was a notable year, many of the meteorological features having been of special interest. A mild winter with only half an inch of snow at its deepest was succeeded by a beautiful spring with an early start of vegetation, and exceptionally fine weather at Easter. Great dryness prevailed from mid-April to the end of May, by which time rain was greatly wanted. With the advent of June came a rainy period which continued more or less (with the exception of a short dry spell in October) to the end of the year, resulting in the year's rainfall reaching the total of 36.90 ins. or 10.42 ins. above the normal fall of 26.48 ins. The Norwich records show only 13 occasions on which the year's rainfall has exceeded 30 ins. viz. :

Year		ins.	Year		ins.
1860	...	34.47	1910	...	31.84
1872	...	34.27	1912	...	35.03
1877	...	30.29	1916	...	32.68
1878	...	33.05	1922	...	32.49
1879	...	31.22	1924	...	30.77
1882	...	34.97	1927	...	36.90
1892	...	30.47			

All the months except May, July, and October gave rain in excess of their respective averages, the wettest months having been September with 7.15 ins., November 5.17 ins., and June 4.80 ins. The mean temperature of the year (49.1 deg.) was in close agreement with the average, the greatest departures having been March, with an excess of 4.3 deg., and December, with a deficiency of 3.4 deg. Sunshine, the returns of which Mr. J. H. Willis has again kindly supplied for each month, was 121 hours deficient, and there were 66 sunless days. Taken as a whole the year was the most ungenial since the disastrous year 1879. The absence of really warm days, the May frosts, almost constant rain throughout the summer, and the wintry visitations in December, concluding with the most extensive snowstorms for many years, and the floods following will remain in memory for a long time to come.

The total eclipse of the sun on the morning of June 29th was well seen by the writer from the pier-head at Southport and was an imposing spectacle, the corona being visible throughout the total phase.

MR. PRESTON'S METEOROLOGICAL RECORDS FOR 1927

1927 Month	BAROMETER					THERMOMETER					HYGROMETER	SUNSHINE	RAINFALL		WIND								
	Highest	Date	Lowest	Date	Mean	Highest	Date	Lowest	Date	Mean	Mean Relative Humidity 9 a.m	Hours	Inches	No. of Days	Direction and Days								Mean estimat'd force
															N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	
	in.		in.		in.	°		°		°	%												
Jan.	30.36	10	29.06	14	29.733	52.0	9	26.2	22	39.3	89	61.6	2.23	19	0	1	0	0	5	12	7	6	3.3
Feb.	30.53	10	29.23	22, 23	30.009	53.0	26	24.2	10	39.5	89	51.5	2.11	16	4	0	5	2	4	6	4	3	2.5
March	30.39	16	28.87	25	29.698	65.5	21	32.4	11	45.8	81	126.9	2.05	20	1	1	1	4	7	6	7	4	3.7
April	30.26	18	29.29	25	29.867	69.0	19	29.4	30	47.7	74	165.7	1.55	15	3	0	1	1	2	2	7	14	3.9
May	30.40	11	29.66	31	30.031	73.4	4	28.5	1	52.3	72	209.7	0.63	12	8	5	6	1	1	3	3	4	3.0
June	30.21	15	29.29	26	29.850	74.2	16	42.5	13	56.1	74	187.8	4.80	22	2	5	1	2	1	2	4	13	3.4
July	30.21	19	29.51	1	29.874	79.0	5	43.8	20	61.0	80	150.9	2.47	18	3	6	4	3	5	4	4	2	3.1
Aug.	30.31	3	29.39	22	29.842	79.0	6	46.0	26	61.9	80	194.4	3.35	19	2	1	5	2	4	8	3	6	3.7
Sept.	30.24	3	28.87	24	29.740	72.8	2	35.0	28	55.9	86	112.1	7.15	21	4	2	3	1	2	2	13	3	3.7
Oct.	30.45	9	29.18	22	30.001	66.8	2	32.0	21	50.9	86	108.3	2.60	18	4	2	3	2	3	5	4	8	3.3
Nov.	30.48	26	29.20	6, 7	29.914	65.0	2	31.1	14	42.8	90	54.6	5.17	20	4	1	5	3	4	2	6	5	3.0
Dec.	30.60	28	28.60	23	29.908	51.0	6	14.2	19	35.5	92	38.0	2.79	18	0	8	13	5	2	1	0	2	2.7
Means					29.872					49.1	83												3.3
Extremes & Totals.	30.60	Dec. 28	28.60	Dec. 23		79.0	July 5 and Aug 6	14.2	Dec. 19			1461 5	36.90	218	35	32	47	26	40	53	62	70	

VI.

THE HERRING FISHERY OF 1927

By A. H. Patterson

The Season of 1927, notwithstanding some stormy periods, greatly favoured the fishermen, who secured a good return for their hazardous toil afloat; but the fish buyers were not so fortunate, since the price of herrings ruled exceptionally high. On the other hand a season of heavy landings would have been equally, if not more, unfortunate, for the Russian market which absorbed the bulk of the herrings before the War, was still closed to us.

What is badly needed is an enlarged market in our own country. A herring at a penny or three-halfpence is good value economically, and if consumption could be stimulated by greater advertisement and distribution assisted by cheaper railway rates, the fishery might even become independent of foreign markets.

With regard to the tabulation of the lasts* of herrings landed, it is difficult to give more than approximate figures, since the different authorities—commissioners, pressmen, and the fishery experts—appear to collect their statistics from slightly different dates, or for different periods. The following summary is taken from the "Eastern Daily Press":—

The writer of these statistics states that landings began on August 2nd, when a drifter brought in "the first shot" of herrings from the grounds off Shields, and supplies from that neighbourhood came in steadily, iced or salted, until September 5th, when the first fresh herrings were landed. On September 22nd the first Scotch drifter, from Peterhead, arrived, having on her way south taken a catch near Smith's Knoll, in local waters. Early in October the Scotch boats were getting to work; the first Scotch shore-workers coming on October 3rd, the invasion of lassies continuing for some days after that. These Scotch lassies include fishermen's daughters and wives and girls

* Herrings are now measured by the Cran—ten crans being equal to one last. The fish are hoisted from the hold in baskets known as "maunds," holding about 200 herrings; these used to be shot into a double basket called a "swill," which contained about 500 herrings—132 to the hundred. Twenty swills made a last, or about 13,200 fish.

from every conceivable feminine occupation. Their stay was exceptionally short, for the Scotties had begun to return northward by November 15th, the last boat leaving the port for Kirkcaldy at the end of the month.

The heaviest landing was 21,591 crans, but 20,042 crans were landed on November 9th. The heaviest week's landing (week ending October 15th) was 97,321 ; the smallest being 1,329 crans. The lightest day of all was November 23rd, when but one boat came in with a single cran, roughly about 1,000 fish.

The number of boats fishing out of Yarmouth Port was 784, as follows :—

Yarmouth, 112 ; Lowestoft, 13 ; North Shields, 6 ; Northern boats, 653.

The total for 1926 was 833.

An increasing number were oil-driven ; whilst many of the one-time sailers have adopted motor power.

It is estimated that the shore-workers included :—

Curers, 112 ; fish workers, 3,456 ; Coopers, carters, and labourers, 650.

It may be stated that the largest single catch made by a Yarmouth boat, the " Rose," taken on October 31st, was 220 crans (= 22 lasts) ; the top catch of a Scotch boat, the " Lydia " of Inverness was 195 crans, caught on October 15th. The highest priced single catch was £441, taken by a Yarmouth boat, " Young John," the " Shot " being 180 crans.

The herrings were somewhat elusive in their shoaling, and the catching was not pursued so near home as usual, the shoals haunting grounds from 30 to 70 miles off, which meant a lessening of the number of runs into port.

Exporting began early ; the first cargo of pickled herrings, in barrels, went to Libau on October 10th. The total of barrels cured at Yarmouth for the continent was 373,955 barrels, nearly half of which had been shipped by the beginning of October.

The fishing fleet was visited on the night of October 28th by a heavy gale, which did serious damage to the fleet fishing out of Lowestoft. The Banff drifter " Witham " was sunk some 30 miles from Lowestoft, the crew being heroically rescued, after very hazardous attempts, by the drifter " Arcady,"

a Lowestoft vessel. A fishermen was drowned from the drifter "Confier." Very great damage was done to the nets.

The arrival of the boats on the Saturday provided busy scenes both at Yarmouth and Lowestoft, some 300 boats returning to the latter port in the evening and well on into the Sunday morning. The authorities of that Sunday-respecting fishing centre broke their record by sanctioning the removal of their catches from the boats on the Sunday, and the packing, salting, and carting away of the fish.

Of the hundred drifters arriving at Yarmouth on the Saturday, many had experienced a rough time in the gale, whole fleets of nets being all tangled up in inextricable fashion. One Scotch drifter, which had earned only £600, lost all her nets; the losses generally being estimated at from £10,000 to £15,000.

A fishing seldom passes without some toll being taken of human life. An engineer was lost from a Yarmouth drifter fishing near the Tyne in August. In October a net-stower was knocked over from the "Chris." The mate pluckily leapt into the sea after him, but both were drowned. The mate of a Wick drifter was drowned in the harbour, and a very gallant rescue at sea has already been mentioned.

VII.

NOTES ON THE FLORA OF NORFOLK

By A. Bennett, A.L.S.

These are additions, records, etc., that have come to hand since Mr. Nicholson's List in Volume XI., p. 601—608. Additions are noted by a *.

Fumaria officinalis L. *f.* suaveolens Pugs. On peas at Ranworth (Salmon and White).

Viola odorata L. var. dumetorum R. and F. Saham Toney (Newton sp. 1919).

Viola deseglisei Jord. Stow (G. C. Druce).

V. ruralis Jord. Sprowston (E. F. Linton). Wroxham (Miss Pallis).

V. arvaticum Jord. N. Walsham (K. Mornington).

V. ANGLICA Drabble. Wroxham (Miss Pallis).

V. VARIATA Jord. var. sulphurea Drabble. Foulsham (Mr. L. Notcutt). Framingham.

V. LEPIDA Jord. Thetford (R. W. Butcher).

V. LUTEA Huds. *f.* pesneaui Lloyd and Foucaud. Croxton (F. Robinson). Santon Warren (J. E. Little).

These seven Violas are recorded by Dr. E. Drabble in Rep. Bot. Ex. Club, p. 197, 1926 (1927).

MEDICAGO SYLVESTRIS Fr. Bawburgh (F. Robinson).

VICIA SEPIUM L. var. ochroleuca Bast. Wymondham Gravel Pit (Mrs. Pomeroy). Sec. R.B.E. Club, 1923.

SEDUM RUPESTRE var. minus Syme. Roadside between S. Walsham and Upton, 1916 (Salmon and White).

*MYRIOPHYLLUM ALTERNIFLORUM. D.C. Near Norwich (Talbot). R.B.E. Club, 1919 (1920). This is quite a common species in most counties, being on record for 85 vice-counties, while *M. spicatum*, which is a common Norfolk species, occurs in 87. It seems curious that *M. alterniflorum* should have escaped observation in Norfolk so long.

APIUM NODIFLORUM var. pseudo-repens Wats, Stow Bedon, 1916 (F. Robinson).

GALIUM ERECTUM, Huds. Heydon Common (Bryant. With. Bot. Arr., 152, 1787).

FILAGO SPATHULATA Presl. W. Runton, 1916 (Dr. Long, sp.).

ARTEMISIA VULGARIS L. var. rubriflora Besser. Between Ingham and Stalham (J. and A. Bennett).

SENECIO PALUSTRIS Hook. Merton, Geldart in litt., 1894.

SENECIO PALUDOSUS L. "Gathered in Norfolk by Mr. J. Sherard, and myself," Sir J. E. Smith (note from Rev. Newbould). Redmore Fen c. 1833—40 (Mr. Marshall of Ely).

TARAXACUM SCANDICUM Dahlst. Hunstanton (G. C. Druce). "Allied to this, teste Dahlstedt," Rep. Bot. Ex. Club, 1926, p. 32 (1927).

MENTHA ALOPECUROIDES Hull. Burgh St. Margaret (R. J. Bindow). Rep. Bot. Ex. Club, 269, 1926 (1927).

MYOSTIS SYLVATICA L. Holt (Rev. R. B. Francis, Hooker Br. Fl. 1830, p. 84).

PYROLA ROTUNDIFOLIA L. The leaves of this species seem to vary considerably. In specimens from Meadow Dyke,

Heigham Sounds, they measure 5 dm. x 2.75 dm. Dubeck in Thurne 3.50 dm. x 3 dm. W. Sutherland, 2.75 dm. x 2.50 dm. Guernsey, 2 dm. x 2 dm. Ireland (bog) 3.50 dm. x 3 dm. The leaves from Meadow Dyke not only vary in size, but are far less coriaceous, the margins distinctly crenate, the veins very prominent, not green, but quite a copper-colour, and the stem bracts are much longer. I have a strong suspicion that the genus is semi-parasitic, and Vuych in "De Plantengroei de Dunen," 1898, p. 159 (Dutch Work) remarks, "Alle Pyrola soorten zijn Semi-saprophyten," but I doubt if they ever destroy their "host," as Orobanche sometimes does.

VERONICA SPICATA L. W. G. Clarke, Trans. XI., Nov. 1924. Garboldisham, July, 1910. Weeting, July, 1913, Messrs. Burrell and Clarke. East Harling, Robinson and F. Newton, August, 1913. West Harling, August, 1922, Mr. Dixon Hewett.

OROBANCHE PICRIDIS. F. Schultz. In this genus, so difficult to name in dried specimens, I had many undetermined. Several I sent to the monographer of the Genus, Dr. G. R. Beck Mangetta. Among them was one sent me by the late Mr. Geldart, who gathered it at Thorpe, near Norwich, in 1894. At the time it was suggested to be a large specimen of *O. minor* Sutt., but it was referred by Dr. Mangetta to *O. picridis*.

This *Orobanche* was first found in England in July, 1848, at Comberton, Cambridgeshire, by the Rev. W. W. Newbould, who took it to Prof. Babington at Cambridge. It was figured in English Botany, t. 2956 Supp., by J. W. Salter, and described by Prof. Babington, April 1st 1849. Since that date it has been recorded from nine vice-counties, and I now add Norfolk and North Somerset.

It is much paler than *O. minor*, of a yellow-whitish shade, and flowers up to the middle of August. The true plant is only known to grow on *Daucus carota*, and *Picris hieracoides*. The *Picris* is described by Mr. Nicholson in the Flora of Norfolk, p. 104 (1914) as "Locally common, or rather rare"; he gives 16 localities for it, so it may occur in other places in the county. I have beautiful specimens seated on the *Picris* from St. Margaret's Bay, East Kent.

OROBANCHE ELATIOR Sutton. Near Cromer, Winch. New Bot. Guide.

*O. RETICULATA Wallr. var. procera Rich. Left-hand side of the road from Stalham to Ingham, opposite the Windmill, J. and A. Bennett, 1900. I was unable to trace on which plant this was parasitic, but it is usually on some species of thistle.

It was identified for Yorkshire! and Cheshire! by the monographer of the genus, G. Ritter von Beck. Since then he has identified for me a pale-coloured variety for Wales as var. *pallidiflora*.

CHENOPODIUM HYBRIDUM L. Snettisham (Robinson, R. Bot. E. Club, 1916).

C. BOTRYOIDES Sm. Chapel Denes, Yarmouth (Paget).

BETA MARITIMA L. Between Runcton Holme and Magdalen (Miss Bell).

POLYGONUM MITE. E. Winch Common (Newton, 1919).

*SALIX LUTESCENS A. Kern. S. cinerea x aurita L. Fakenham (Dr. White, Jour. Linn. Soc. 385, 1891).

MALAXIS PALUDOSA Sw. Burgh, near Yarmouth. 1840. (J. Backhouse in York, Phil. Soc., Herb. !)

GOODYERA REPENS Br. Holt (Miss Crache ex J. Robinson, 1915, Rep. Bot. Ex. Club, 373, 1916).

*ORCHIS HIRCINA Crantz. Haddiscoe, "60 flowers" Rep. B. Ex. Club, 215, 1924.

There could hardly be a more unlikely place to find this *Orchis*. Some ten years ago it was reported that seed of this *Orchis* had been sent, or brought to England.

SPARGANIUM NEGLECTUM Beeby. Pond at Fordham near Downham, 1924 (J. E. Little sp.).

*POTAMOGETON PUSILLUS L. subsp. lacustris Pers. Ditch by river near Lammas Church, 1900 (C. E. Salmon).

P. TRICHOIDES C. and S. var. Trimmeri Casp. Dr. Caspary named this after the Rev. R. Trimmer as our plant has an umbo, and crested carina, while in the typical specimens in the Berlin herbarium these are absent.

P. COLORATUS Hornem. Blackfleet Dike (J. and A. Bennett). Salthouse and Stow Bedon (Robinson).

CAREX CURTA Good. Ashwicken (Newton, 1920).

Calamagrostis stricta Timn. var. pallida Rupscht. (1845). [var. viridis Torges (1899)]. This was found by Mr. Robinson in marshy ground at Hockham (1914).

C. canescens Web. var. pallida Lange. Horning Ferry, 1915 (Salmon and White).

Festuca ambigua Le Gall. Beachamwell Warren (J. E. Little sp.).

Poa bulbosa L. Old walls. Horsefair, Norwich (S. P. Woodward). Ann. and Mag. N. Hist. 1841.

Ceteracii officinarum Willd. Gathered on Heydon Church in 1854 by S. O. Gray.

Lastrea cristata Presl. Scoulton Mere, 1875 (Dr. Plowright. Trans. ii. 131, 1875–6).

Equisetum palustre L. var. pseudo-sylvaticum Milde. Moss Lane, Stalham (Salmon and Bennett).

Pilularia globulifera L. E. Winch Common (Newton, 1919 sp.).

Chara connivens Braun. Martham Broad (Salmon and White).

C. vulgaris L. var. longibracteata Kutz. Stow Bedon (Robinson sp.).

Polygala dunensis Dum. is what we have been calling *P. oxyptera* from the coast. The inland "*oxyptera* auct. angl." is really the *P. dubia* of Bellynck. Dumortier (he spelt his name Du Mortier) in a pamphlet named "Bouquet du Littoral Belge," 1869, gave a very useful list of the genus *Polygala*, with their descriptions, dates, etc., from 1753 to 1855.

VIII.

WILD BIRD PROTECTION IN NORFOLK IN 1928

Report of the Committee

In strong contrast with 1927, the almost continuous four months of sunshine—from June to October—during the past season will long be remembered by those who have the good fortune to live in Norfolk, and by those who visited the county during this long spell of fine weather. A more favourable season for reproduction among birds could hardly be imagined; food supply both on the coast and inland was plentiful, and consequently we are able to present to our subscribers what it is hoped will be considered a satisfactory report.

In the following pages are recorded the chief items of ornithological interest that have come to our notice during the season, and we once again thank our supporters for the help they are giving us in the protection work for which we are responsible.

Breydon

For the past quarter of a century a watcher has been employed on Breydon Water during the summer months, with a two-fold object: firstly, to record the different species that visit this estuary; and, secondly, to act as a deterrent to gunning on the area during the closed season. The Society's house-boat, in which the watcher lives, is moored in the Ship Drain and commands an uninterrupted view of the higher "lumps," or mud-flats. To these the birds return first on the ebbing tide, and so accustomed have they become to the house-boat that they will feed within a few yards of it. As the successor of George Jary, who held the post for twenty-five years, William Betts, of Great Yarmouth, has been appointed as watcher, and was on duty from April 2nd to August 31st. It is from his journal that the following information has been extracted.

With the in-coming of May, as is usually the case, there was a very large accession to the number of waders. For example, on May 1st between 200 and 300 Whimbrel arrived and settled within a few yards of the house-boat; "So tired were they that the moment they rested they put their heads under their

wings and went to sleep." Again, on May 4th, about 100 Bar-tailed Godwits came in. After resting and feeding for about forty-eight hours these birds all continued on their northward journey.

Two Spoonbills arrived on May 6th and stayed until the 14th ; these were the only Spoonbills that visited Breydon this year. On the 20th a large white gull appeared and was joined by another two days later ; evidently either Glaucous or Ivory, but the identification was never made certain. On the bluff at the Burgh Castle end of Breydon a few pairs of Sheld-ducks always nest ; this year the first brood was seen on May 27th. During August there was a large influx of Curlew-sandpipers, which were unusually common on the Norfolk coast this autumn.

Cley and Salthouse

Between February 15th and September 15th the Cley Marshes are left entirely undisturbed, and during this period the watcher is on duty ; indeed, he is on duty for the whole of the year, because during the winter months he is employed as keeper by the shooting tenants. During last season shooting took place on seven different days, and a detailed record of the ducks obtained (kindly supplied by Mr. Colin McLean) is given on page 489 of this report. It might be thought that this shooting would scare the ducks permanently away from the marshes, but such is not the case, as the records show, and as we ourselves have personal experience. Only on suitable days, that is, in rough weather, are the marshes shot, and our experience has been that on the following day the ducks are " using " the marshes again as their sanctuary. In a gale of wind from the north, and especially if there are accompanying blizzards, the ducks cannot settle on the sea and so keep returning to the marshes, where they would seem to pay little heed to the report of the guns ; by the next day they have forgotten all about it. This would not be so if the marshes were shot on still days ; they would then all leave and probably not return for two or three weeks.

During the first week in January a Bittern was several times seen, and on February 5th two rose from a reed bed near the watcher's hut.

At a visit on February 2nd the writer counted forty-two paired Sheld-ducks on Salthouse Broad. These birds nearly all leave the Norfolk coast about the end of August and return in yearly-increasing numbers to breed. A month later, on March 4th, forty Wild Swans were seen by the watcher passing eastward ; from their call-notes they appeared to be Whoopers.

Only one Spoonbill visited the marshes this year, on March 31st, and stayed for the night. The number of these birds that came over to Norfolk this summer was less than usual.

On May 3rd the writer found a large number of Whimbrel and Godwits at Cley, many of the latter " in the red." This was obviously part of the large immigration that was noticed on Breydon on the same date. On the same day he took four eggs from a supposed Garganey's nest on the marshes, which the watcher had found, and which had been forsaken for ten days. These Mr. McLean placed under a hen and three Garganey chicks were eventually hatched. At this time there were several Sandwich Terns on an island on Salthouse Broad, and later on there were about sixty nests, in addition to about the same number of Common Terns' nests ; they had a good hatching.

Herons come in numbers to feed on the Cley marshes, and on August 12th the writer counted sixty-nine.

The East Bank, which divides the marshes from Salthouse Broad, is one of the best places in Norfolk for observing ducks, waders, and other sea birds, and the Committee is pleased to find that this undisturbed vantage point is being more and more appreciated by bird watchers, many of whom are supporters of the Norfolk Wild Birds Protection Fund.

Blakeney Point

Not since Blakeney Point has been supervised by a watcher (during the nesting season) has there been such a large colony of terns nesting on the Far Point as during the past season. It is the opinion of all familiar with this ternery that the birds have increased during the past few years, but, as fluctuations in numbers are common at all terneries, this fact of itself would not be of much significance were it not accompanied

by other changes. Topographically, the area is altering, and in place of more or less level shingle ridges on which Common Terns used to nest there is now developing a semi-circular system of dunes on these ridges, well shown in Professor F. W. Oliver's photograph reproduced in our last report (page 342). These dunes are still in their infancy, but now that they are becoming clothed in vegetation their growth is rapid. It is at the foot of these embryo dunes that the Sandwich terns lay their eggs in the bare sand, because, unlike the other species of terns, there is never any attempt at nest making. The Common Tern prefers the more level shingle beaches, or if they nest in dunes, as they do in the neighbourhood of Great Sandy Low, they prefer dunes of older formation.

In 1921 the Sandwich Tern nested for the first time on Blakeney Point; in the following year there were nine nests, and in 1923 there were upwards of 100 nests. The arrival of this species was concurrent with the beginning of the formation of the new Far Point, and since then their numbers have gradually increased until 1928, when a conservative estimate of the numbers might be put at 1,000 pairs.

With this increase in the number of Sandwich Terns the Common Terns nesting on the Far Point have slightly diminished in number, and during the past season it was estimated that there were about 500 pairs. In addition there were about 200 pairs of Common Terns nesting in and around Great Sandy Low.

The first egg hatched this season, that of a Common Tern, was on June 8th, and two days later the first Sandwich chick was found. The hatching of both species then proceeded apace, and by July 5th there were quite a number of young terns able to fly. From this date to the end of the month the ternery appeared to be a moving mass of young terns; no high tides nor other adverse conditions affected the birds this season and a good food supply was maintained all along.

Within a few feet of the site of last year's nest a pair of Roseate Terns nested again this year. The birds were first identified on May 17th—an early date—and two days later Pinchen found their nest containing one egg. A second egg was laid, and on June 19th two strong chicks were hatched; these both survived, and on July 1st were ringed with upwards of 600 other young terns.

It is not often that other species of birds will venture to nest on a thickly-populated ternery, though last year a pair of Redshanks made their nest in a tuft of grass on one of the small dunes. This year a pair of Oyster-catchers made their nest in the middle of the ternery and hatched off on June 21st ; the three chicks were ringed.

That the watcher may have a closer supervision of the birds during the egg-laying period, the Committee has purchased a house-boat, which is moored on the ternery ; it provides sleeping accommodation, and from it the birds can be observed at close quarters without disturbing them, under all conditions of weather.

Scolt Head Island

When, in 1923, this island was purchased by public subscription from Lord Leicester and handed over to the National Trust, the Norfolk Wild Birds Protection Committee undertook to provide a watcher, and for the first three years such a one was engaged for the summer months only. But it soon became obvious that there was much to be done on the island at other seasons of the year, and so, in 1926, a whole-time watcher was appointed in the person of Charles Chestney, of Brancaster Staithe, who has occupied this position for the past three years. His house is in the village, but he is able to get across to the hut in twenty minutes, and whenever he thinks it desirable he spends the night at the hut.

Even to the ornithologist the ternery is but one of the many attractive features of the island, which lies on the migration route of a number of species, and there are extensive feeding-grounds for waders, which can be watched at close quarters from the dunes. The suæda bushes and other vegetation afford protection to the smaller passerine migrants, and by judicious planting it is hoped further to attract this class of birds. An account of this afforestation scheme, now being carried out under the supervision of Mr. Douglas Carruthers, is appended to this report.

With regard to the terns, the nesting season was disappointing. On April 17th a few Sandwich Terns were seen out at sea by local fishermen, and six days later three were seen by the watcher over the island. On the 24th both Common and Little Terns

Photo] [*F. W. Oliver*

SCOLT HEAD ISLAND

The Hut, with the rain water catch-area in the distance.—July 20, 1928

BRITISH
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5 MAR 29
NATURAL
HISTORY.

were fishing over Norton Creek, and by the 26th there were about fifty Sandwich Terns on the ternery. On May 16th the first Common Tern's egg was found, and on the 21st there were five eggs of the Sandwich. At this time there were about 150 Sandwich Terns on the ternery and it looked as if they intended to settle down for nesting. But cold and unsettled weather followed and the birds never seemed to be "at home," and a climax was reached on May 25th, when very cold, windy weather set in and lasted for thirty-six hours. During the whole of this time the island was enveloped in a sandstorm, and nearly all the chicks were either choked by sand or died of exposure—dozens were picked up dead by the watcher the next day. This seems to have been the last straw so far as the Sandwich Terns were concerned, for they all left in a body that night and, presumably, joined up with the Blakeney Point colony. A few odd pairs returned and laid, but only two chicks were hatched and these died of exposure ; the remaining eggs were either sucked by gulls or became embedded by blown sand. The Common Terns were not so disheartened, but after the storm of May 25th to 26th started to lay again and had a good second hatching. There were about 300 pairs of Common Terns in the colony.

Of Little Terns' nests, ninety-four were found by Chestney, and about thirty more on the golf links side of the harbour, where there were also several Common Terns' nests.

The extensive shingle beaches provide nesting sites for numerous Ringed Plovers. Thirty Redshanks' nests were found and four of the Lapwing. Fourteen nests of the Oyster-catcher were found ; twelve on the island and two on the "Nod" on the south side of Norton creak. One Oyster-catcher died egg-bound within a few yards of her nest containing three eggs. The male bird, identified by its being lame, found another mate, which hatched off three young within twenty yards of the first nest. The deserted eggs in the original nest were taken by rooks. Sheld-ducks' nests were numerous, and it seemed as if almost every rabbit's burrow in the dunes was occupied by a pair of these birds. During the past two years the number of rabbits on the island has considerably decreased, and this may explain the increase in the nesting Sheld-ducks.

Throughout the early months of the year, and as late as May, two pairs of Short-eared owls frequented the island, and one of these pairs nested on the marsh within a few yards of the site of the nest of 1926. Five eggs were laid and all hatched off, and the whole family remained about the island until the beginning of September. Their food consisted largely of young Common Terns. The old birds raided the ternery every evening, and it is safe to say that the undigested remains of a large number of young Common Terns hatched on the island this year were eventually ejected as owl pellets.

The Broads District

From the accounts we have received from the various owners and their keepers in this part of Norfolk we are able to report that good protection is afforded during the nesting season. Towards the end of March there was a large influx of Garganeys, and on the 31st we saw from twenty to thirty pairs on one of the broads. Several of these nested in the district. 1928 will be remembered as a Marsh-Harrier year. At one time in the spring there were seven of these handsome birds to be seen in the eastern part of the county, and three pairs remained to nest. One nest was deserted after the young were hatched, and these were transferred to the other two nests in each of which four were reared to the stage of flight. It is not known that more than one pair of Montagu's Harriers nested in Broadland this year.

Of the number of Bitterns' nests we have no record, but the birds are plentiful, though we do not hear of nests outside of the Broads district.

Yellow Wagtails were very scarce this year, and in one locality, where nests are usually numerous, only one was found last season. There were no nests on the Cley marshes, where a pair or two are generally to be found.

There was a good hatching of Bearded Tits in some parts of the Broads district, but in others, where they were at one time common, none were to be seen. There is no doubt that the severe cold of last winter diminished the numbers.

Photo] [*F. W. Oliver*

SCOLT HEAD ISLAND

The hut plateau from the west, showing basal protection from lapping waves by osier hurdles, and recently-planted marram on the slopes. Note *Statice reticulata* on marsh in foreground.—June 20, 1928

thousands of Wigeon and Mallard were seen passing westward over the sea at Cley and Blakeney—obviously all oversea birds. This experience on the North Norfolk coast does not support the opinion held by some, that the duck population of the northern hemisphere is diminishing.

For comparison, Captain H. Cator has supplied us with the records of the Ranworth and Woodbastwick shoots—adjoining properties—for the past eight years, from which it will be seen that, with the exception of the season 1924-25, there has been a progressive increase in the ducks obtained. Further points of interest about these records are the large preponderance of Wigeon and Teal at Cley as compared with the more inland waters, where the Mallard is the commonest species ; the great increase in the numbers of Shovelers and Teal at Ranworth during recent years ; and the very considerable number of Pochards and Tufted ducks that come to Hickling during the winter. This year both of these species nested at Hickling. The Cley marshes are very exposed, and this is probably one reason why the Mallard prefer the more secluded and protected waters. No shooting takes place at Ranworth after the tenth of February.

Under the system as carried out at Ranworth, where a number of ducks are caught and pinioned each winter for breeding stock, and where the Broad is kept undisturbed except when shot, it is seen how greatly the number of ducks can be increased—from 457 in 1920-21, to 2,050 in 1927-28. If one's intrusion upon the Broad is not sudden and is made silently the ducks are not alarmed and one is able to watch them at close quarters. Here, as at Cley, shooting is allowed only on suitable (windy) days, and it is found that twenty-four hours after the shoot the birds have all returned to their " sanctuary."

Signed (on behalf of the Norfolk W.B.P. Committee),

SYDNEY H. LONG, *Hon. Sec.*

DUCKS SHOT AT HICKLING DURING THE SEASON 1927-28

(From Information Supplied by Jim Vincent, with Permission of Lord Desborough)

	Mallard	Teal	Garganey	Shoveler	Wigeon	Pintail	Tufted	Pochard	Scaup	Goldeneye	Common Scoter	Goosander	Smew	Total
Aug. –	148	10	—	10	—	2	—	1	—	—	—	—	—	171
Sept. –	70	2	1	—	—	—	—	1	—	—	—	—	—	74
Oct. –	33	1	—	1	2	—	1	5	8	—	—	—	—	51
Nov. –	32	10	—	3	2	—	3	18	2	—	1	—	—	71
Dec. –	18	1	—	—	—	—	11	26	1	2	—	—	—	59
Jan. –	135	70	—	—	1	—	77	36	1	2	—	1	2	325
Feb. –	32	20	—	11	1	—	46	46	—	—	—	—	—	156
Total –	468	114	1	25	6	2	138	133	12	4	1	1	2	907

DUCKS SHOT AT RANWORTH AND WOODBASTWICK DURING THE SEASON 1927-28

(From Information Supplied by Captain H. Cator)

	Mallard	Teal	Shoveler	Wigeon	Gadwall	Pintail	Tufted	Golden eye	Pochard	Goosander	Merganser	Smew	Total
Aug. –	15	7	6	—	2	—	—	—	—	—	—	—	30
Sept. –	29	3	9	—	—	—	—	—	—	—	—	—	41
Oct. –	47	6	1	1	—	1	—	—	—	—	—	—	56
Nov. –	202	148	27	12	1	—	3	—	2	1	—	—	396
Dec. –	338	65	20	14	1	5	7	—	2	1	1	2	456
Jan. –	310	25	7	3	—	1	4	—	2	—	3	—	355
Feb. –	97	7	5	1	—	—	1	1	—	—	1	—	113
Total –	1038	261	75	31	4	7	15	1	6	2	5	2	1447

To the above figures must be added 55 Mallard and 6 Teal not recorded by Capt. Cator in his game-book.

Of the 546 Mallard caught during the Winter 1927-28, 4 were caught in November; 485 in December; 47 in January; 10 in February.

RANWORTH AND WOODBASTWICK DUCK SHOOTS

(From Information Supplied by Captain H. Cator)

1920-21	1921-22	1922-23	1923-24	1924-25	1925-26	1926-27	1927-28
Ranworth	Ranworth	Ranworth	Ranworth	Ranworth	Ran. & Wood.	Ran. & Wood	Ran. & Wood.
Mallard 381	Mallard 509	Mallard 457	Mallard 819	Mallard 458	Mallard 920	Mallard 426	Mallard 1619
Teal 55	Teal 38	Teal 70	Teal 42	Teal 162	Teal 224	Teal 188	Teal 267
Shoveler 8	Shoveler 1	Shoveler 6	Shoveler 4	Shoveler 23	Shoveler 23	Shoveler 40	Shoveler 75
Wigeon 8	Wigeon 14	Wigeon 28	Wigeon 26	Wigeon 34	Wigeon 26	Wigeon 4	Wigeon 31
Pochard 2	Pochard 5	Pochard 1	Pochard 2	Pochard 2	Pochard 10	Pochard 1	Pochard 6
Tufted 2	Tufted 4	Tufted 6	Tufted 13	Tufted 1	Tufted 1	Tufted 1	Tufted 15
Merganser 1	Merganser 2	Merganser 2	Merganser 5	Pintail 1	Goldeneye 1	Pintail 1	Pintail 7
—	Goosander 2	Goldeneye 4	Goldeneye 3	Gadwall 1	Garganey 1	—	Goldeneye 1
457	Smew 1	Garganey 1	Smew 1	—	Goosander 1	661	Gadwall 4
	—	—	Goosander 5	682	Smew 1		Merganser 5
	576	575	—		—		Goosander 2
			920		1208		Smew 2
			Of the above 489 Mallard were caught	Of the above 152 Mallard and 3 Teal were caught	Of the above 248 Mallard were caught	Of the above 51 Mallard were caught	Bernicle Goose 1
							—
							2035
							Of the above 546 Mallard and 1 Tufted were caught

LIST OF SUBSCRIPTIONS AND DONATIONS TO THE NORFOLK WILD BIRDS PROTECTION FUND FOR 1928

	£	s.	d.
H.M. THE KING	3	3	0
H.R.H. The Prince of Wales, K.G. ...	2	2	0
Adam Miss H. ...	1	1	0
Adcock E. D.... ...	1	1	0
Agnew C. G.	1	1	0
Allars R. W. E. ...	3	3	0
Allen J. W. ...	1	1	0
Allen Ernest ...	1	1	0
Baker E. S. Stuart ...	3	3	0
Barclay F. H. ...	1	0	0
Barclay H. G. ...	2	2	0
Barnard Mrs. ...	1	1	0
Barrow Miss		10	6
Barry W. J.	1	1	0
Barton S. J., M.D. ...	1	1	0
Bedford, Her Grace the Duchess of ...	2	2	0
Beevor Sir Hugh, Bart.	1	0	0
Bidwell E.	0	10	0
Blakeney Point Collecting Box	2	3	2
Boardman E. T. ...	1	0	0
Boileau Sir M., Bart.	1	1	0
Boyle Mrs.	0	5	0
Brash T.	2	2	0
Briscoe Lieut. F. M. Eliot-Drake ...		10	0
Brittain H. ...	1	0	0
Brooks J. R.... ...	1	1	0
Brown E.	1	1	0
Brown H.	1	1	0
Buckle Lt.-Col. D. W.	1	1	0
Bullard Ernest ...	1	1	0
Bulwer Col. E. A. ...	1	0	0
Burrowes R. B. ...	1	0	0
Burrows Mrs. ...	2	0	0
Burton S. H., F.R.C.S.	2	2	0
Butcher R. W. ...	1	0	0
Buxton E. G. ...	2	2	0
Buxton G. F. ...	3	3	0
Buxton W. L. ...	1	1	0
Byne Lt.-Col. R. M. ...	1	1	0
Byers J.		10	0
Calley Miss J. M. ...	5	0	0
Candler Charles ...		10	6
Carr Mrs. Laurence ...		10	0
Carruthers D. ...	2	2	0
Cassie R. L.		10	0
Castle J. W.	3	3	0
Chadwick Dr. Morley	2	2	0
Chamberlin Sir G., the late	1	0	0
Carried forward ...	£70	6	2

	£	s.	d.
Brought forward ...	70	6	2
Chapman E. H., His Honour Judge ...	3	3	0
Christie J. A., M.P. ...	1	0	0
Churchill Mrs. Arnold		10	0
Cleminson H. M. ...	1	0	0
Coates John		10	0
Coe Mrs. A. E. ...		10	0
Colman Miss E. ...	1	1	0
Colman Miss H. C. ...	1	1	0
Colman R. J. ...	1	1	0
Colomb Admiral P. H., C.B.	1	0	0
Cooke A., F.R.C.S. ...		10	0
Cowper Johnson K. ...	1	0	0
Cozens-Hardy A. ...	1	1	0
Cresswell Mrs. George	1	1	0
Cruickshank W. G. ...		11	0
Davy G.		10	0
Deacon Dr. G. E. ...		10	0
Dew Mrs., the late ...		10	6
Dewar T. F., C.B., D.Sc., M.D. ...		10	0
Dewrance Sir John, G.B.E.	2	2	0
De Worms C. ...	1	1	0
Doughty C. G. ...	1	1	0
Drury G. L.		10	6
Duncanson T. J. G. ...	3	3	0
Eccles James R. ...	1	1	0
Edwards Francis ...		10	0
Ennion E. F. R. ...		10	6
Ferrier Miss Judith ...		10	0
ffolkes Sir W., Bart....	1	1	0
Fiennes Lt.-Col. J. T. W.	1	1	0
Friedlein W. ...		10	6
A Friend		5	0
Garrod F. W.... ...	1	1	0
Gay Miss C. E. ...	1	1	0
Gay Miss Grace ...		5	0
Gayner Dr. J. S. ...	1	1	0
Giles C. C. T. ...		5	0
Glanville J. P. ...	1	1	0
Glegg W. E. ...	1	0	0
Goddard W. N. ...		10	6
Gossage Col. W. W. and Mrs.	2	2	0
Gowen H. P.... ...	1	1	0
Graves Mrs.	1	1	0
Green Major E. A. Lycett		10	0
Gresham School Nat. Hist. Soc.	1	1	0
Carried forward ...	£112	11	8

	£	s.	d.
Brought forward ...	112	11	8
Gurdon E. T. ...	1	1	0
Gurney Q. E. ...	1	1	0
Gurney G. H. ...	2	0	0
Gurney R., D.Sc. ...	1	1	0
Gurney W. S. ...	1	1	0
Hannaford G. ...	2	2	0
Harding J. Rudge ...		10	6
Hare Sir Ralph, Bart.	1	1	0
Harker W.	1	1	0
Harmer T. Bertrand...	1	0	0
Haydon W.		5	0
Herbert E. G. ...	1	0	0
Heywood R.	1	1	0
Hill T. A. M. ...	1	1	0
Hills Dr. Harold W....		10	0
Horsfall R. E. ...		10	0
Howlett Dr. J. K. ...		10	0
Hudson Lt.-Col. Percy C.M.G., D.S.O. ...	1	0	0
Hughes W.	1	1	0
Jago Cyril		10	0
Jessop A. L. ...	2	2	0
Jones Sir L., Bart. ...	1	1	0
Jones Lawrence E. ...	2	2	0
Ketton-Cremer W. C.	1	1	0
Keith E. C.	1	1	0
Kinder Rev. E. H. ...	1	1	0
Knight E.	1	0	0
Kolle H. W.	2	2	0
Lang Gordon L. ...	2	2	0
Lee-Elliott Rev. D. L.	1	1	0
Littlewood Miss ...		10	0
Lister S. R., M.D. ...		11	0
Lewis J. Spedan ...	2	2	0
Lloyd Capt. L. ...	1	0	0
Long Miss		5	0
Long S. H., M.D. ...	2	2	0
Lucas Dr. G. ...	1	0	0
MacAlister Mrs. ...	1	1	0
Macpherson A. Holte	1	1	0
McKenna Mrs. R. ...	1	1	0
McKenzie Miss G. ...		10	0
McKittrick T. H., Jun.	2	2	0
McLean C.	1	1	0
Marshall J. M., J.P....	1	1	0
Matthews J. G. ...	1	1	0
Maynard Miss J. ...	1	1	0
Meade-Waldo E. G. B.	1	1	0
Meadows Mrs. A. H....		10	0
Mennell E.		5	0
Micholls Mrs.... ...	2	2	0
Millard Miss I. M. ...		5	0
Milne Mrs. Findlay ...	1	1	0
Mitchell Arthur ...	1	1	0
Moxey J. E., the late	1	0	0
Carried forward ...	£171	5	2

	£	s.	d.
Brought forward ...	171	5	2
Murton Mrs. ...	1	0	0
Nash John E. ...		13	0
Nash W.	1	0	0
National Trust, The...	10	0	0
Naylor W. S. ...	1	1	0
Newman Miss F. B. ...		10	0
Nockoldonian Society, The		10	6
Oliver Prof. F. W., F.R.S. (1928 & 1929)	2	2	0
Pain P.	1	1	0
Pearson S. W., M.D....		10	0
Penrose F., M.D. ...	1	1	0
Plowright Dr. C. T. ...	2	2	0
Poole Miss D. Lane ...		2	6
Powell A. M.... ...		5	0
Preston Sir E., Bart., D.S.O.	1	1	0
Purdy T. W.... ...	1	1	0
Ransome Mrs. ...	1	1	0
Raikes Miss D. T. ...		5	0
Richmond H. W., F.R.S.	5	0	0
Riley W.	1	1	0
Ringrose B. J. ...	1	1	0
Riviere B. B., F.R.C.S.	2	12	6
Robertson W. K. ...		10	6
Rogers Rev. H. ...	1	0	0
Rose L.	1	0	0
Rowntree W. S. ...	1	1	0
Royal Society for the Protection of Birds	2	2	0
Ruggles-Brise Mrs. ...	1	0	0
St. Quintin W. H. ...	1	1	0
Savill Harry	2	2	0
Savin A. C.		5	0
Savory Mrs.		10	0
Scolt Head Collecting Box	3	13	6
Sewell P. E. ...	2	2	0
Sheldon W. G. ...		10	6
Simpson F. T. ...	2	0	0
Smith Col. H. F. ...	1	1	0
Soman A. E. & Co., Ltd.	1	1	0
Spalding G.		10	0
Southwell E. B. ...	1	1	0
Steward Rev. Canon Edward	1	1	0
Stewart G. B. ...	2	2	0
Stimpson E. ...	1	0	0
Strachan C. E. ...	1	1	0
Sumpter Dr. B. G. ...	2	2	0
Tancock Canon O. W.		5	0
Taylor Dr. Mark ...	1	0	0
Thompson C. R. W.		10	0
Thompson W. H. ...	1	0	0
Carried forward ...	£238	17	2

	£	s.	d.
Brought forward ...	238	17	2
Thorpe W. H. ...	1	1	0
Thouless H. J. ...		10	0
Tuke Anthony W. ...	1	1	0
Upcher H. E. S. ...	1	0	0
Upcher Miss L. ...	2	2	0
Vincent T.		5	0
Walter C. H. ...	1	1	0
Watson J. B. ...		10	0
Wells C. H.	1	1	0
Whittaker W. I. ...	1	1	0
Carried forward ...	£248	9	2

	£	s.	d.
Brought forward ...	248	9	2
Winch Major S. B. ...	2	2	0
Wormald H.	1	1	0
Wright B. D. Z. ...		10	0
Wright T. J. ...		10	6
Wyllys H. J. M. ...		10	0
Wyllys W. E. ...		10	0
Yeo H.		10	6
Yeo Mrs.		10	6
Sales of Report ...		3	0
Total ...	£254	16	8

NORFOLK WILD BIRDS PROTECTION FUND

Year ending December 31st, 1928

Receipts

	£	s.	d.
Balance from 1927	124	14	7
Subscriptions, 1928	249	14	0
Blakeney Collecting Box ...	2	3	2
Scolt Head Collecting Box ...	3	13	6
Sales of Report		3	0
Grant from the National Trust towards House-boat for Blakeney Point	5	0	0
	£385	8	3

Expenditure

	£	s.	d.
Breydon Watcher's Wages ...	38	0	0
Scolt Head Watcher's Wages to October 25th, 1928	84	7	0
Blakeney Point Watcher's Wages (contribution towards) ...	30	0	0
Punt and Requisites for Breydon Watcher	6	6	0
Telescope for Breydon Watcher		17	6
Coal, etc.	1	17	6
Insurance, Breydon Watcher	3	9	3
Ditto, Scolt Head Watcher (half year)		19	6
Printing of Annual Report ...	10	0	0
"Ratinol"	1	18	0
Cheque Book		2	0
Stationery and Appliances ...	2	17	0
Postage, Watchers' Diaries, etc.	6	9	8
To Norfolk Naturalists' Trust	80	0	0
House-boat for Blakeney Point Watcher	22	18	9
Balance	95	6	1
	£385	8	3

Deposit

	£	s.	d.
Balance, 31st December, 1927 ...	80	1	11
Interest to 31st December, 1927	1	4	1
Ditto to 30th June, 1928 ...	1	4	2
	£82	10	2

Examined and found correct

W. A. NICHOLSON

Honorary Auditor

1st November, 1928

IX.

EXPERIMENTAL PLANTING ON SCOLT HEAD ISLAND

By Douglas Carruthers

In the winter of 1924-25 the first experiment was made in the formation of plantations of trees and shrubs on the sand-dunes of Scolt Head Island.

The position chosen was a hollow in the so-called "House Hills," *i.e.*, the sand-dunes to the south of Smugglers' Gap, and to the east of Butcher's Beach, where there was a ruined hut (called "the House"—and now rebuilt). Here there is a hollow, more or less sheltered on all sides by low sand-hills, and it was supposed that the shelter thus afforded would enable young trees and shrubs to make root-growth and gain foot-hold—a supposition which was eventually proved to be wrong. Another reason for considering this flat a particularly suitable site, was because any plantations formed had to be wired against rabbits. Wiring across sand-dunes is notoriously difficult, if not impossible, but on the flat it is comparatively easy. During the first two years, no rabbit gained entry to the enclosure; only when the latter was enlarged, so as to include more marram-covered sand-dune, did we have rabbit trouble.

Two thousand five hundred square yards were enclosed with 250 yards of rabbit netting, which stood two feet six inches above ground and was sunk one foot below.

This "low" or "flat" in the dunes is covered with close "turf,"* only a small portion of the area being overgrown with marram grass; there is no *pure* sand without vegetation. But the sand in the low is not very deep; at a depth of two feet the shingle is reached. Also water is at no great depth, for we opened up a pit twenty-five feet long and five feet wide, and about six feet deep, and found brackish water, which very rarely disappears entirely. The water rises and falls with the tides, and is sometimes as much as five feet deep.

*"Turf" may seem to be an exaggerated term to use for the close-grown mat of moss, lichens, grass, etc., forming a carpet, which can be lifted like turf from a lawn—but I can think of no better word. For full description of the vegetation of this area see Trans. Norfolk and Norwich Nat. Soc., 1924-25, Vol. XII., Part I., page 95-6.

During the first summer, 1925, in spite of a prolonged drought in June, the water never entirely disappeared. Although brackish (Dr. Sumpter undertook the analysis and found it to contain 370 parts salinity per 100,000,—the average for sea water being 3048 parts and for drinking water on the coast 10 parts per 100,000), it was the only *surface* drinking water on the island for bird-life, and was frequented by many small passerine birds—on hot summer days there was a constant stream of linnets and the like visiting the pool. Later in the season it was frequented by flocks of goldfinches, which were doubtless also attracted by the fine crop of thistles which sprang up, as if by magic, on the shingle bank formed by the material excavated to make the pool.

The general scheme of the plantation was as follows :— To form a permanent shelter-belt on all sides of Austrian and Corsican pines, and to plant such other trees as might be expected to flourish, namely : Maritime and Scots Pines, and such hard-woods as sycamore, ash, birch, elder, willow —all of which are growing on the Holkham dunes, a few miles to the eastward. Inside the tree belt there was ample room for an experiment in planting such shrubs as might withstand the winds and be unaffected by the saline nature of the air and soil. In this list were included Tamarix, Privet, Elder, Tea-plant (*Lycium barbarum*), Sea-buckthorn (*Hippophæ rhamnoides*) (vetoed by the committee on the grounds that its introduction might eventually mean the banishment of man !) —bramble, broom, and gorse. All these might reasonably have been expected to succeed and, as the following account shows, are succeeding, or will succeed during the next few years as experience is gained. In years to come, when the tree belt has formed a protection, it is probable that a great number of shrubs will prove quite easy to acclimatise to the somewhat strange environment, but not until the shelter is forthcoming. On the Holkham dunes of the same character, now that the pine belt is matured and the marram has been eliminated, it is interesting to see what a variety of trees and shrubs are growing up of their own accord.*

*I myself have noted on the Holkham dunes, apparently self-sown—but well-established—specimens of oak, elm, sycamore, walnut, willows, birch, hawthorn, and elder ; also privet, honeysuckle, and *Clematis vitalba*.

In 1925—the first season—planting was begun by the writer, assisted by Dr. B. G. Sumpter, in early February; this was on the advice of Mr. Munro, Senior, Lord Leicester's ex-Forester, who planted the Holkham dunes in the seventies. He advocated "wide planting, late planting, and the planting of sturdy young stuff grown in exposed nurseries on the sea coast." Wide planting to foster slow, vigorous growth, so as to produce trees retaining their lower branches; shelter, not commercial value, being the object in view. Late planting, to avoid the gales to which young trees planted before Christmas would be subjected. The Holkham trees were planted, as they stand now, six to eight yards apart, no thinning having taken place. Many of these trees were planted as late as April. Essential to success is the degree of hardiness of the young stuff planted. Austrian and Corsican Pines can stand any amount of wind and weather if rightly grown in the nurseries. On the other hand, if "softly" grown, they will succumb immediately on being transplanted to an unsheltered site. The first season's experiment showed this. Austrian pines of four years' growth, twice transplanted, died; Corsicans of short growth survived but did not add one inch to their growth.

I was warned against Scots pine, but curiously enough the best tree in the plantation at the present moment is a Scots given us by Mr. Chilvers, of Hunstanton.

When I reported to the Committee on the first season's work, I was able to say that some hundreds of Austrians, Corsicans, and a few Scots pines had been planted, and that in addition we had planted 292 specimens of shrubs, generously given to to the Committee by Mr. Chilvers, of Hunstanton. These included Ribes, Rubus, Privet, Berberis, Broom, Tree Lupins, Bush Honeysuckles, Laurels, Lycium, Tamarix, Olearia, Veronica, Colutea (Bladder Senna), Euonymus; also poplars, willow, birch and elder.

I remember reporting that "at the present moment the Salix are in blossom, the ribes in leaf, and the bush honeysuckles look as if they did not mind their novel surroundings."

Now as the to result of the first year's planting. Nearly all the shrubs were cut down to the ground by the salt wind, but invariably shot up again from the root. Some of the young plants died, which may have been due either to the exceptionally

trying season of 1925,* or to the quality of the stuff planted, —which was possibly too old, or too " softly " grown. Notably successful were the bush-honeysuckle (*Lonicera ledebouri*) and tree lupin ; but Tamarix, a native of salt deserts, died back to the root. Of the Austrian pines the majority of the trees failed. By the end of 1925 I was beginning to see a little light. Early in 1926 all failures were replaced by sturdy young stuff, not more than six to nine inches high, which had been grown in my own nurseries at Barmer, seven miles from the sea. This was not as exposed a position as I should have liked, but the trees had been well spaced and not cramped for room and air. Moreover, all showed a good clump of fibrous roots which we were able to lift with a lump of soil ; and each tree was wrapped in paper for transport, and planted, with most of its roots undisturbed, in its final position on Scolt Head. This entailed considerable labour, but was essential to success. With a view to establishing young trees in these uncongenial surroundings a small nursery was started inside the enclosure on the island. Trenches were opened up and the top spit including the turf was dug-in and well mixed. Here one-year-old seedlings of Maritime pines raised at Barmer from seed collected in the forests of Arcachon (Gascony) were pricked out. Also seeds of broom and gorse were sown. Broom and gorse failed as young transplants, but grew quickly from seeds sown broadcast.

The growing season of 1926 was a bad one, there was the March drought, " drier than any on record," followed by an autumn drought, " the driest August of the century."

By December, 1926, it appeared obvious that the benefit derived from planting in a hollow for the sake of the shelter of the surrounding dunes was outweighed by the fact that the hollows were still saline, whereas the sand-dunes were not ; the hollows were frost traps, the sand-hills were above the frost line. We therefore decided to enlarge the enclosure

*In March there were persistent dry northerly winds. In April there was a gale of unusual violence (83 miles per hour). In May there was recorded the unusual temperature of 80 deg., which heralded in a long spell of perfect summer weather of the continental type, in fact June was practically rainless, and during the whole month no depression passed across our islands. Many records for drought were broken. Again in July there were periods of high temperature, 92 deg. being recorded at Hunstanton on the 22nd.

in order to take in more of the high dunes covered with marram grass and to plant there. This was done early in 1927, and with the aid of a good wet year the plants have benefited. No tree or shrub planted on the dunes failed, many made good growth, and even the little Maritime pines in the nursery bed had grown almost too much. We introduced another shrub, which seems to take very well to its new surroundings, *Baccharis patagonica*. Mr. Victor Ames* one day in 1926 gave me as many cuttings as I could carry away in my car, with the result that the rooted cuttings now cover quite a large area of dune. They are growing well now and survived the ordeal of 20° of frost in December, 1927. There are also some Salix growing well on the dunes, and the shingle bank is rapidly becoming covered with gorse.

By the winter of 1927-28 we were transplanting the Maritime pines, now sturdy young trees, on to the surrounding dunes above the hollow, some inside the enclosure, and others outside —encircling each with a ring of wire netting. The principal failures, the reason for which I am unable to account, are Tamarix, elder and *Lycium barbarum*. It would appear obvious that all these should grow, and grow rapidly. Large bushes of self-sown elder, sweet briar, and bramble are to be seen on the tops of the dunes around the plantation; also many readers will know the great Tamarix clump opposite the Club House at Brancaster.

Taking it for granted that the failures have resulted from the position chosen for planting, rather than from error in selection, I am this season evacuating the hollow and moving all the Tamarix, etc., up on to the sand-dunes.

Another part of the scheme has been the planting of the big horse-shoe hollow, or "blow-out," in the high dune above the Hut. This was planted by the watcher (Chestney) with marram grass and Sea Purslane (*Atriplex*). We also planted a small colony of Austrian pines in the big hollow to the east of Scolt Head, while some of the bare sand faces on the south were covered with self-layered pieces of privet or elder cut from bushes on the Island. These seem to thrive on pure sand.

*To Mr. Victor Ames I am indebted for many a car-load of cuttings from his unique garden at Thornham. Whenever I called to see him he not only encouraged me in my enterprise, but loaded me with cuttings, and gave me unstintingly of his great knowledge of sea-side planting.

The season of 1928 was favourable for the dune-planted pines. They were not harmed by the drought of July, and all grew considerably, adding about six inches to their height. The plantation at House Hill showed that the dune-planted trees and shrubs survived when those planted in the hollow below succumbed. The Maritime pines, now two-year seedlings, grew without a check, and *Baccharis patagonica* seemed to have established itself.

X.

VIGNETTES FROM HOLLAND

By F. W. Oliver

In the following pages are thrown together a few of the impressions gained in a recent hasty visit to Holland. The primary object of the visit was to see the results of planting experiments of Spartina on unreclaimed tidal muds, but my friends would not suffer me to depart until I had seen quite a number of typical parts of the country. After inspecting the Spartina work in Zeeland I was taken through North Brabant, Gelderland, Overijsel, Drenthe, and Friesland. At Stavoren I parted from my host and made my way to Amsterdam and so home.

These impressions are grouped here under four headings, connected by a common thread, the soil. The soil of Holland has been won by the labour and accumulated practice of centuries, and signifies more to the Dutch, perhaps, than does the soil of any other country to its owners. So, in successive sections, I deal with the Spartina experiments, which not improbably will be the means of giving a fresh impulse to land reclamation from the sea; the Real Holland, where vestiges of original terrain, find mention; their love of flowers; and finally, under the title Joy-Riding, some account is given of Holland as it appears from the air. Fully to realise the wonder of the thing called Holland, which the Dutch have created, it must be viewed from aloft.

All these things were made possible through the great kindness of my friend Dr. J. P. Lotsy (the "Host" of these pages), his younger daughter, and Dr. J. W. C. Goethart,

Director of the Rijks Herbarium at Leiden, and possessor of a capacious and comfortable "Chandler," which in his skilful hands, carried the party over the length and breadth of the land in luxury and safety.

Spartina

Holland being a country mainly reclaimed from sea and river, sandy heath and peat bog, any agency likely to promote an acceleration of any of these operations is sure of a welcome. Nearly 60 years ago a Gift from Heaven appeared on the salt marshes of Southampton Water—a grass which became known as *Spartina Townsendii*, and which has since spread aggressively along the muddy shores of both England and France. This plant is supposed by some to be a natural hybrid of our indigenous species *Spartina stricta* and of an American introduction (*Spartina alterniflora*) dating a century ago. However this may be, *Spartina Townsendii* has the unique faculty of colonising soft, bottomless muds better than any known plant, raising their level, and advancing to a marked degree the date of reclamation for agriculture of such ground.

For 25 years this superplant has interested me, and my observations have produced an unshakable faith in its reclaiming powers. Numerous small plantations have been made privately in this country, but a "try out" on a large scale has been lacking. England to-day has no great economic need of more land; we are unable to use what we have to the best advantage. The Dutch, on the other hand, appeared to have every inducement to make a success of Spartina, combined with an age-long experience in the handling of ground.

At this stage the interest of my host (Dr. Lotsy) was enlisted. He was attracted not only by the potential value of Spartina to Holland, but also, I suspect, by the fact that it might be a hybrid. As a result of a visit to Poole Harbour and other English localities in 1923, he satisfied himself that the case was good, and was successful in arousing the interest of the Dutch Government in the matter. The following year, at the request of their Government, Dr. Lotsy in company with Mr. A. G. Verhoeven, maritime engineer in charge of reclamations, etc., in Zeeland, visited together Southampton Water, the Beaulieu River, and other localities on the Hampshire coast,

as well as the estuaries of the Medina, Newtown, and Yar Rivers of the Isle of Wight. As a result of a detailed survey of Spartina localities a first batch of 50 cuttings went to Holland, and subsequently tens of thousands.

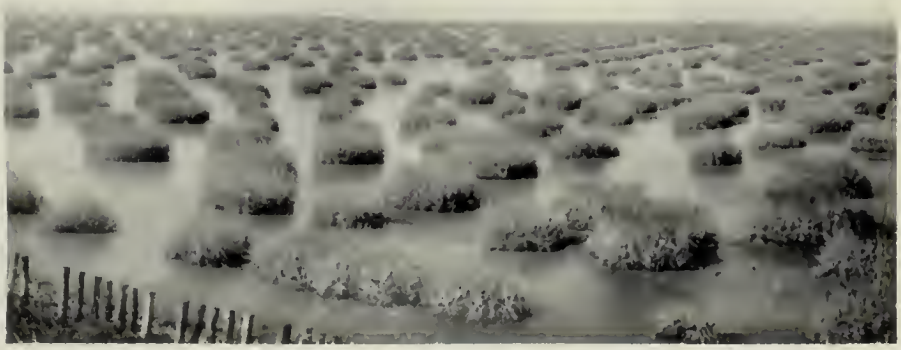
From 1924 onwards numerous plantations have been made on the tidal lands in various localities, especially in the Scheldt, and it was to examine the progress of these experiments that the present visit to Holland was arranged.

For this purpose Middelburg in Zeeland served as base—a selection which could not have been bettered. Middelburg is the capital of Walcheren, an island of polders with marginal sea defences.

In the almost tropical weather which prevailed in September the Abdij Hotel formed a cool and refreshing retreat. Situated in the great Abbey Square, it derives coolness from the noble canopy of trees with which it is filled. At the hours and the quarters the silence is broken by the sweet chimes discoursed from the adjacent belfry of Lange Jan ; and as boys also come here in the late afternoon to play leap-frog, there is no fear of stagnation. Middelburg has the indefinable air of being a metropolis—second to none. Though mediæval and dignified, life flows through its narrow streets. The centre of an agricultural country, peasants come and go in their national costume—a costume not likely to die out for the reason that it enhances the beauty of the women. A Dutch girl I knew paid me a surprise visit one day, arrayed in this ravishing costume, a vision of loveliness. To my question why she did not oftener wear it, she replied, " Because people would ask why I wasn't always so pretty."

The port of Flushing, a short drive away, is an objective for occasional evening excursions for recreation or a concert. It lies at the southerly point of the island, where the channel of the Scheldt comes close inshore, and the stream of ocean traffic, to and from Antwerp, makes an unfailing attraction. East of Flushing a branch of the Scheldt turns north, separating Walcheren from S. Beveland. This channel is the Sloe, and here, just south of the railway embankment, are some of the Spartina plantations.

These plantations have reached an impressive phase. The Spartina cuttings are mostly planted in the muds at three-meter



1. Part of Plantation of *Spartina Townsendii* on the muds of the Sloe (Holland)

2. One of the Lakes in the Dutch Nature Reserve at Oisterwyk

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intervals, and have made three, and sometimes four years' growth—such plants averaging 6 to 7 feet across. By 1930 the units should meet to form continuous meadow. The most extensive of these plantations, covering about a square kilometer of mud, lies right across the Sloe just south of the dam on which runs the railway from Flushing to the Continent of Europe. Our photograph (Pl. 40, Fig. 1) shows a small sector of this plantation, taken from the E. end of the Sloe dam, looking S.W. It will serve to illustrate the extraordinarily thorough way in which the work is being done. The plants flower and seed freely by their second year, and self-sown seedlings can be detected in the foreground (on the right) of the picture. These seedlings are found useful for extending the lines further out, and are reported to give better results than cuttings. This patch alone must contain something like 50,000 tufts—an enormous undertaking when it is borne in mind that on the less soft muds a man can plant 500 a day, whilst on the softest, into which he sinks deep, only 200. The Dutch workers scorn the help of mud boards and go barefoot.

The whole of the work is under the direction of Mr. A. G. Verhoeven, and if Spartina should find a permanent place in the reclaiming methods of Holland, it will be due to his energy, judgment, and technique. What impresses Mr. Verhoeven is: (1) The sturdy way in which Spartina settles in to its work, establishing, expanding, and flowering freely; (2) that it can occupy at once soft, mobile, untamed muds; and (3) raise their level perhaps 6, 8, or more inches a year. If this promise is borne out, it means that ground treated with Spartina should be ready to polder (i.e., bank in) at least ten years earlier than would otherwise have been the case; as this is cumulative, it means a great deal in terms of the country's future. There are other plantations in the Sloe, of which that arising from my host's original 50 cuttings should become historic. The tufts put out in May or June, 1924, are now over 10-feet in diameter, and practically touching one another.

A few miles south of Bergen-op-Zoom (near the Kreekrak Polder) another plantation shows well the power of the plant to raise the mud level. This, although somewhat younger than that on the Sloe dam, consisted, it seemed to me, of even more vigorous units. The flowering haulms were quite one meter

high, which is in excess of anything I had previously seen—though since my return I have seen specimens from opposite the discharge of the effluent from a sewage farm at Holes Bay (Poole) which are fully a foot higher than that.

Spartina had also been put to other exacting tests at the Kreekrak Polder under which it had further demonstrated its capacity, but these need not be described here. No doubt shortly an official report on the cultivation will be prepared and published, setting forth all requisite details.

After inspecting these convincing experiments, it is evident that a new era has opened for Spartina, and the world should have no cause to hesitate in utilising it wherever ground, climate, and economic conditions are favourable. As a botanist it was a delight to meet an engineer who by his own experiments had convinced himself that plant ecology has something to contribute to the solution of the practical problems with which he was occupied.

As the Sloe area is fully accessible to the passing traveller, being visible from the trains crossing the viaduct, let me emphasize the spectacular character of this plantation. Hundreds of lines of Spartina tufts stretching away from the foot of the bank to a distant perspective; lines which, as you change station are continually re-shuffled and picked out again as secondary lines in other directions. This is the work of men who had their heart in the job, and forms a unique, if fleeting, monument to their faith and industry.

I am sometimes asked whether Spartina will be of any use in connection with the operations for reclaiming the Zuider Zee. The answer is, not directly. The Zuider Zee is a distinct problem. A large area of relatively shallow water is being confined behind sea walls, and will be pumped out much as the Haarlemmer Meer was pumped out, years ago. At some future time Spartina might find an application in raising the level outside these walls, with a view to poldering, but this has no immediate interest. The truth is, from a Spartina expert's point of view, the Zuider Zee is an unfortunate distraction!

But in good time things will settle down. The need for poldering is unquenchable, and Verhoeven's demonstrations show very decisively the part which Spartina has to play. His work on the regulation of mud is perfectly comparable to

Sören Biörns' discovery, in 1795, of the right way to handle Marram Grass (Psamma) in the regulation of sand dunes. A discriminating posterity may be expected to honour alike these two men as the pioneers in their respective fields.

To my host and Mr. Verhoeven I am greatly beholden, not only for the great privilege of this "private view," but also for the admirable way in which it was organised. The order in which the plantations were shown, being as far as possible the order of their establishment, was particularly illuminating, as it enabled me to reconstruct, step by step, as no other method could, just how these brilliant successes had been reached.

The Real Holland

My Dutch friends always affected concern lest my devotion to polders and the methods and results of sea level reclamation should lead to a warped and imperfect view of the country. There was high ground to the east, rolling country, even hills where gear had to be changed. It was also evident that this country, historically far older than Zeeland, etc., appealed to their hearts in a manner which differed in quality from the low-lying reclamations. Whether this is a primitive instinct or a reaction from life in polders, who shall say? But low country people seem prone to erect high towers, like Lange Jan at Middelburg, the Belfry at Bruges, and our own Boston Stump. At Middelburg high platforms on the stepped gables are pointed out where the merchants of former times could keep watch for their returning Argosies.

And so a trip from S. to N. was arranged, embracing N. Brabant and much that lies between that province and Stavoren in Friesland.

For the purposes of these notes, then, this section which deals with the moors and heaths, and the Nature Reserves which are located therein, shall be called "The Real Holland." Here also reclamation is making rapid strides, and it is no wonder if far-sighted men should conserve a certain number of untouched areas to show what Holland sprang from. These areas are held by the Dutch equivalent of our National Trust, and the movement, which has already secured several famous

properties, is well supported by naturalists who administer them in the interests of natural knowledge and beauty.

The first reservation to be visited included the meres and sandhills of Oisterwyk in N. Brabant, an area to which the public are freely admitted. It consists essentially of a number of elongated lagoons or meres occupying valleys scoured out by the wind from a massif of inland sand dunes. The sand hills are close-planted with Scots Pines, which are felled with discretion as they mature. As the country round about is also pine bearing, the limits of the reservation are not always evident. As with our own Burnham Beeches, it is easy, as we soon discovered, to lose the way at Oisterwyk.

This unusual mingling of meres and pine-covered dunes in ever varying combination of water, trees, and reflections (Pl. 40, fig. 2) has great scenic charm, but for the Naturalist the great attraction of Oisterwyk is the vegetation of the meres. The deeper parts carry water lilies, white and yellow, and in their proper zonation pretty well all the aquatic plants of the temperate zone are in evidence. Phragmites, Typha, Scirpus lacustris, Menyanthes, Alisma, Frogbit, Hypericum elodes, Pondweed, Polygonum, Equisetum, Water Soldier—everything. I never saw so many representative aquatics together ; whilst on the banks amid dripping Sphagnum are Droseras, Liverworts, Mosses, and peaty plants.

It is a feature of these lakes that they are isolated and not connected by rivulets. This isolation explains why no two of the meres have identical floras ; it is the chance of dispersal not corrected by a circulation of the water. And so, in hot pursuit of some cherished plant (e.g. Isoetes or *Lobelia Dortmanna*) which ought to be there, one is drawn from mere to mere, regardless of time and space. Some day the separate pools will be listed and the spell of the chase broken !

The Administration of this Reserve have a rule posted here and there prohibiting smoking between May 1st and September 30th, lest the forest should become ignited. Privately, as a sinful man, I thought it a harsh law . . . Are there not little insects ? . . . but I was a guest and no doubt the Administration know best.

Next morning we were out betimes seizing a few more hours before the time of our departure. As we left our *Pension*,

which was well outside the precincts, my host lighted a cigar and I a pipe. Presently, oblivious of such things, we blundered into the arms of the Guardian who reproved me for smoking. The actual position at the moment was that my host had long ago finished his cigar, whilst I was merely continuing to carry an extinguished pipe in my mouth. I tried to behave as a brave man should in adversity, but it was undeniably "one up" for my host.

Our wanderings led us into Overijsel and Drenthe, regions of peat and moor. Reclamation goes on apace, and districts which as recently as 30 or 40 years ago were uninhabited, and accessible only on horseback or on foot, are now under full cultivation, with roads, farms and villages everywhere. The taming of sandy heath and of peat bogs are distinct arts, having in common accurate knowledge of what should be done and capacity for unremitting labour. Strips of the old country, "The Real Holland," still remain and their retention (in moderation) amid smiling fields and arable has much to recommend it.

At Koornberger Ven not far from Winterswyk (in Gelderland), we visited another of the Society's Reservations, an extensive area of primaeval fen, very strictly preserved. Scenically, this area has the advantage of our Wicken Fen as it can be traversed on a causeway, raised somewhat above the general level. The flora seemed a rich one, and several of the rarer marsh orchids were noticed as well as an example of the natural hybrid, *Vaccinium Myrtillus* x *V. Vitis-idaea*. Not far away were elegant fairy rings of *Lycopodium chamaecyparissias*, recalling the same mode of occurrence in *L. fastigiatum* in old pastures in New Zealand. I am much indebted to the courtesy of Dr. J. P. Thijsse for the opportunity of visiting this Fen.

In Overijsel two other localities remain fixed in my mind, viz. the peat moors on the German frontier near Enschede, and the very beautiful combination of sand dunes and lush, fertile pastures on the River Dinkel. Both these places would have repaid leisurely botanical examination.

The distances to be travelled in visiting a few places near together in this part of Holland are often very great. For in a newly-developed district the roads run where they can and

not along ideal lines. A distinct advantage from my point of view was that I saw a great deal of the country; it was perfectly marvellous how rarely Dr. Goethart was at fault in finding the way.

Our exploration of the peat and fen district of Drenthe included a visit to the recently built laboratory of the Beijerincks at Wijster amid a multitude of peaty meres. Dr. W. Beijerinck, in addition to his algological researches, was investigating the plants, bones, and other remains from the terpen of Holland, which give results comparable to those from kitchen middens. Terpen are high artificial mounds used between 1000 B.C. and A.D. 800 as places of refuge by the inhabitants and their stock when the sea broke the sea walls, in days when these defences were less reliable than they have since become. Just beyond the newly-planted garden was one of these meres from which the stumps and roots of former trees projected because of the drought, whilst growing in the shallow water were *Lobelia Dortmanna* and other plants proper to such situations. Along the shore were grains of "colloidal" peat which had lost the power of imbibing water, and which if present in sufficient quantity might be built up by the wind into black dunes. Another mere at no great distance lay amid sand dunes where *Salix repens* was a conspicuous agent of fixation. Here also Marram Grass has been planted, probably to prepare the way for reclamation, whilst large stretches of heath were being industriously planted with *Pinus sylvestris*. After enjoying the gracious hospitality of the Beijerincks, we returned to Meppel which was for the time being our head-quarters in Drenthe. Meppel is a pleasing town with canals and shipping, and the centre of delightful country. From it we visited Giethoorn, one of several places claiming to be the "Venice of Holland." The village consists of little farms ranged along a canal and buried in trees. The little properties are separated by minor canals or ditches, and high, little rustic foot bridges form a great feature. The essential traffic is conducted by punting, in which art the inhabitants have been experts for centuries. The charm of the place to a visitor depends on this combination of little canals, innocent of concrete revetting, trees and dwellings, and the fact that the canals are in constant use in place of roads. We met

a barge on its rounds returning empty milk churns to the cottages from the central cheese factory. Eventually we found our way into a mere or broad from which we got a view of the cattle in the pastures, with the tree-embowered village beyond. This mere is fashioned rather like one of the smaller Norfolk Broads, with Typha and long belts of water soldier, and here and there the rare *Limnanthemum nympheoides*. The shallow bottom is covered with Characeae.

In another direction we made our way to a remarkable dolmen at Havelte, situated on a heather moor in a lonely district. It is an elongated structure with at least 24 stones in a double row forming the usual passage, surmounted by about 8 unusually massive tables, still in position. It is an impressive structure, well set off by its wild surroundings. Where the stones came from, and how they were placed in the positions they occupy, I cannot imagine. In other parts of Holland where stones are rarities, they are even to-day erected at cross roads and the like. Thus near Winterswyk (in Gelderland) a tall tapering stone has been mounted on a platform and suitably inscribed. Wanting to record the locality for a plant my host said "put 'Near the great stone of Winterswyk.'" In another direction from Winterswyk, marking a point on the German-Dutch frontier, we found what may have been a similar stone rudely chiselled with the arms of the respective countries on either side. It dates from the middle of the 18th century, and stands in a peat bog.

My exit from the "Real Holland" was by Friesland, a country differing in quality from anything previously seen. The great feature is the vast expanse of pasture land, dotted over with tall, pyramidal farm houses. These houses are of fine construction, and often stand silhouetted against the horizon; as they are laced together by the lines of trees on the dykes the whole effect gives a most pleasing and rhythmical pattern. The dyked coast line of the Zuider Zee was followed, and we explored the edges of the Tjeuke Meer and another, lying inland to the port of Lemmer. This latter is a most attractive place where many water-ways converge, and there was a busy traffic of barges. Seen from the curved jetty outside it makes a noble composition. With the draining of

the Zuider Zee, Lemmer will be land locked, though doubtless provision will be made for maintaining the continuity of the canals with the open sea. That evening I crossed from Stavoren to Enkhuizen and so to Amsterdam.

Flowers

The precious soil of Holland is meet only to produce the best, as the flowers prove. Wherever you go gardens are conspicuous, brilliant and glowing with colour as gardens should. I say " conspicuous," but Holland, if you travel at speed, seems to be a pageant of colour. Every cottage, every farm, has its colour scheme, and, as you enter the suburbs of any small town, the display becomes riotous. It is not so much the actual species grown as the scale and standard of cultivation that tells. Moreover, the effect is greatly enhanced by the absence of high walls and boundary fences. The individual efforts are pooled so that everybody can enjoy everything. The same holds for the larger estates or parks of the more prosperous classes, as at Arnhem or Oosterbeek. A belt of trees without undergrowth borders the road, whilst between the trunks vistas of glowing flower beds are revealed. Nor did I notice, either from within or without, any infringement of that privacy to which everybody is entitled.

Without attempting to enumerate the sorts of plants grown, there are two or three which are universal favourites. One of these is the Golden Rod (Solidago) and another the bronze coloured Rudbeckia, whilst a corner is usually reserved for Cosmos. The September display owes much to the Dahlia, which the Dutch have improved almost beyond recognition.

Roadside trees are universal, especially elms and poplars. The roadway is determined in the low-lying districts by the width of the dyke on which it rests, and the trees, being close planted and encroaching somewhat on the fairway, hamper such motor traffic as makes use of them. There are beautiful woodlands near Arnhem, and Roosendaal is famous for its unexcelled avenues of elm and lime. The advance of the Elm disease is apparent and disquieting, but so far as I noticed sporadic rather than devastating. It is much to be hoped some means of overcoming it may be discovered.

The woodlands about Arnhem are upkept by private owner-

ship, after the manner of many great estates in England. Here and there some of this land has fallen into other hands, as near Beekhuizen (Velp) where certain slopes have been taken over by nurserymen for the supply of trees and shrubs to settlers in an expanding neighbourhood—one such enterprise bearing the name " Kew Gardens." The versatility of the Dutch in discovering special lines of exploitation was illustrated by an enclosure of several acres carrying Spruce Firs, very close planted and about 3-ft. high. Of these little trees there must have been at least 30,000 to the acre. They were destined to meet the Christmas Tree requirements of the myriads of of families who dwell in flats in Amsterdam, and as the time approaches, middle men will come and bargain for the entire stand. As these little trees will be sold at about 1/- each, a useful profit should accrue.

The Dutch begin their gardening early. In April every child who cares to apply receives an identical set of cuttings of common plants, and is expected to send the results to an exhibition arranged for the purpose in September. Such an exhibition happened to coincide with the week-end I spent at Velp, and the daughter of my host had the happy inspiration of taking me to see it. It was held in a large and shady garden, and the five pots brought by each child were arranged in rows all along the paths in such a way that comparison was easy. The plants in this instance were Fuchsia, Pelargonium, Begonia, Tagetes, and Ageratum. The judges had just awarded the prizes and I suppose about two-fifths of all the exhibits were classed. A corner of the exhibition ground with the children just beginning to arrive, is shown in the photograph, pl. 41, fig. 3. To the unsuccessful remainder coupons for sweets, chocolates, or ices were allotted, so that everybody got something. It was wonderful to see how this rather exacting test " separated " the exhibits, and also how well many of the plants were grown.

Concurrently with the exhibition was held a floral fête to which the children brought such objects as prams, bicycles, little carts, parasols—indeed anything that could be wheeled or carried—decorated with flowers (see pl. 41, fig. 4). The whole of Velp turned out, and headed by a band, our children's carnival marched through the principal streets making its way

eventually to the exhibition ground, where the prize-winners were announced. The children had made use of all sorts of cultivated plants, though Dahlias predominated. Although there was a rather natural tendency to smother the objects decorated, quite a number of more simple schemes of tasteful decoration were submitted. The whole affair went off well; everybody was happy, and the children keen and interested. From an educational point of view these fêtes and competitions must give a big impulse to a practical knowledge of plants, and as they are general throughout Holland, may account for the high standard of cultivation remarked on above.

From a thousand signs it was evident that child welfare is a deep concern with the Dutch. Of fussy supervision there is none; but if the machinery of welfare lies hidden, its results are manifest. Torrents of chattering, radiant atoms, happy, free and hatless, career everywhere on their push-bikes during rush hours. All classes are there, the finest product of this happy land.

Another aspect of popular horticulture is shown by the present craze for growing cactuses and other succulent plants. Wherever you go a table is to be found, usually in a glazed verandah, bearing a collection of these plants. They told me that succulent plants had not been so popular for over 100 years. This craze is strongly promoted by the inclusion of "Cactus Cards" in packets of biscuits, cakes, etc.—on the lines of the familiar "Cigarette Cards."—Long sets of these are issued, admirable, coloured pictures of the plants, and corresponding albums with blank spaces to receive them. The collections of cactuses are taken very seriously, and the horticultural firms and biscuit people involved are reported to be doing well.

Joy Riding.

8.45 a.m. found me at the Schiphol aerodrome (Amsterdam). Here all was new; offices with staff quarters conveniently arranged around a glazed court, restaurant with spotless service, and, as we passed through, a small boy standing on a stool was cleaning the slate of yesterday's records of arrivals and departures. At 5 minutes to 9 the three passengers were let through to the level and spacious aerodrome, where the

3. Exhibition of Rooted Cuttings by Dutch children at Velp (Holland)

4. Decorated Exhibits paraded by children at Floral Fete at Velp

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ground staff were still tuning up the 2 engines of the big Fokker monoplane (H.N AEF) which was to take us to Croydon, with a call at Rotterdam, en route. We climbed into the fusilage of the machine where there were seats for 15, and the Observer joined the Pilot in the cockpit—a few steps up from the forward end of the cabin.

Punctually at 9 we taxied off, the big Fokker leaving the ground as lightly as a " Moth." The size of the machine may be judged from the wheels of the undercarriage, which rise shoulder high. After circling round, a course was set for Rotterdam at a height of 1500—1200 ft. And now for the first time I could study from above a part of Holland wholly reclaimed from the waters by human effort. From an aeroplane the earth seems perfectly detached; just an endless toy world, unrolling. There are the white lines on the dykes which are roads, accompanied usually by strings of green beads which their shadows proclaim to be trees. The field units are oblong strips like dominoes, ruled with the precision of a mapping pen. The lines between, which shine like silver threads as they take the sunshine, are the drainage ditches. The colour and texture of these strips vary according to the phase of cultivation, standing crops, roots, stubble, plough or grazing, at least 30 different shades of green, russet, buff, and yellow can be recognised, with beasts scattered on some; on others the harvest massed in straight lines and other figures, or heaps of manure in process of being or about to be spread. Human beings subtend a small angle, but wree often made conspicuous by the flash of a steel tool in the sunlight. In the corners of the properties are the projections of the farm buildings, fruit trees, gardens and flower beds. Now and then a canal is crossed, or some mere (as at Gouda or Bergsche Plas) with dykes and dwellings, but not yet emptied of water.

As the cabin hangs well below the single plane, excellent, uninterrupted, ground prospects are obtained from the windows. These rise and fall like the windows of a motor car and gave me full opportunity to photograph. Under the conditions then prevailing (and they lasted till the English coast was reached) the plane formed a stable platform. The noise of the engines was hardly perceptible till I discovered that the usually very pronounced click of the camera had become inaudible. As

there were so few passengers I was able to wander from side to side at pleasure. Though we must have been travelling at 100 miles an hour, at this height it would have been quite feasible, with a little practice, to have sketched a continuous chart of the receding ground up to a width of some 2 miles. Things don't appear to rush violently past one like the sides of a road from a motor car, but just retreat majestically and in good order.

After about 20 minutes the engines were cut off and we planed down to the Rotterdam aerodrome, where there was a 10 minutes' stop. On stepping out we were greeted by a photographer whose self-imposed task was to persuade travellers to pose in front of the machine in which they were travelling. As one of my companions was changing into a machine going to Basle, I sent the photographer in hot pursuit and snapped him as he ran. The few minutes' wait was occupied by the mechanics in further conditioning our engines.

As we took off from the aerodrome I was watching the ground intently, and at the final acceleration before the rise I noticed a large and unusually perfect fairy ring of a fungus resembling a Coprinus (but probably some other genus) 30—40 ft. in diameter and right in the fairway. It was a thrilling moment, but the take off came just in time and we missed making havoc among these shaggy receptacles by inches. The camera was on a seat just out of reach, so an opportunity unlikely to recur was lost.

Our course now lay over S. Holland and the islands of Zeeland. The greater interest attached to the crossing of the wide channels of which the muds and bordering marshes were plainly visible. Details of the plant zonation could be recognised through field glasses, so steady was our flight. As we approached Middelburg, where the ground was now familiar, I looked for the Sloe and its Spartina plantations. This was some distance away to the S.E., and all details were blotted out by the bright sunshine and slight ground haze. We passed right over the tall tower of Lange Jan (280 ft.) which contains the famous chimes which I had heard so often 10 days previously. Middelburg from the air is a beautiful object and bears out the favourable impression formed on the ground; its larger buildings and squares and

streets with trees make an admirable composition. Next, Flushing was recognised, and my last impression of Zeeland was the line of sand dunes bordering the Scheldt and the numerous groynes intersecting the foreshore.

We now stood out to sea at a distance of 2—3 miles from the land, keeping parallel to the Belgian and French coast lines till abreast of Calais. The various resorts—Knocke, Blankenbergh, Ostend, Nieuport, etc. were recognised, and the famous mole at Zeebrugge, like a hockey stick, but no details owing to the dazzling sunlight on that side.

Below us the sea looked drab, and the effect of the waves was to make the relief of the surface resemble, except in colour, the skin of an orange. Many ships were sighted, but you would hardly realize they were moving except for the long wakes they left behind them. Our own shadow showed well on the sea, below to our right, and somewhat in advance. Its position relative to ourselves was a very sensitive indicator of any change in our course.

Shortly after passing Calais we turned out to cross the Channel, a passage rapidly made. The most spectacular event of the trip was the entry into England. Suddenly the chalk cliffs between Folkestone and Dover became visible, a dazzling streak of the whitest white I have ever seen—the sun shining from behind us, intensifying the effect. Moreover, instead of being seen, as from sea level, with the sea below and the sky above, the white cliff was bounded by the smooth green turf of the Downs. As we came right above the cliff it narrowed, first to a ribbon, then to a white line as it vanished, and we were floating over a grassy carpet which ended abruptly in the sea.

The undulating English landscape with its untidy lay-out of straggling towns was in extreme contrast with what we had just seen in Holland. So too was the irregular patched cultivation, the roadside wastes and pieces of common.

We were now passing through (overtaking) occasional flecks of white cloud, though it appeared as if we were stationary and the clouds were meeting us at speed. From this moment our progress became unsteady, and though neither of the passengers was afflicted with air-sickness, it is reasonable that these sudden, not to say violent buffetings should have an effect. The rolling and pitching of a ship at sea differ in one respect from

similar movements in the air, in that there is a definite rhythm in the movement. At sea you know what to expect, and if on deck you can see the waves approaching. In the air this is not the case. I could detect no periodicity or other means of anticipating these joltings, and it may well be that this uncertainty may have a differential value. But whether it accelerates or retards the symptoms, I lack the necessary experience to say.

Of our passage over Kent three observations may be mentioned. Everything from the air is seen in miniature—toys—and the nearest parallel I can suggest (as a botanist) for the oak woods with coppice is to compare them to a surface clothed with vesicles of the Alga Botrydium, with still smaller Botrydiums coming up between. The comparison, if somewhat far-fetched, is very close.

Passing great houses with parks, the great house is relatively insignificant. What tells in the picture is the geometrical patterns of the gardens, especially where concentric circles and symmetry of design are involved. It is to be expected that in the future, when everybody flies, this fact will be taken advantage of, and that pleasure grounds will be laid out in characteristic and alluring patterns. Resorts also will develop on these lines to attract visitors, for people will tire of flying for flying's sake, and tend to go to places which tattoo themselves in ornamental and novel designs. Ranges of glass houses are also conspicuous, and it seems not unlikely that buildings like the Crystal Palace may come into fashion once more.

Perhaps the most beautiful detached object I noticed was just a common allotment. It was all little patches and strips of different shades of colour, rather irregularly arranged, corresponding to the rows of cabbages, carrots, spinach, etc. Each patch had its own texture and colour, and from our height the allotment resembled a lovely fabric embroidered in different colours and with different stitches.

We were now nearing our journey's end; I glimpsed a train leaving the tunnel at Sevenoaks, and as we approached Biggin Hill, I concentrated attention in the direction of Limpsfield, hoping to pick out my own house on the Common. In this I was disappointed owing to the glare from the south.

However, as we crossed Warlingham Hill and turned into the

Caterham Valley I was able to identify Sir David Prain's house. Next we were planing down among the scarlet villas of Purley to make a perfect landing at Croydon. The officials remarked on our rapid passage (we were 40 minutes in front of the time table) as they considerately passed the luggage through the Customs, and by noon, exactly 3 hours after leaving the Shiphol aerodrome at Amsterdam, I was delivered at the gates of University College by the K.L.M.'s speedy motor-bus. The distance is about 250 miles, and the actual flying time on this occasion, $2\frac{1}{4}$ hours, or an average rate (including windage) of 1 mile in 34 seconds.

XI

OBITUARY

SIR EUSTACE GURNEY

1876—1927

The death of Sir Eustace Gurney on December 3rd, 1927, has deprived the Society of a member who, although he rarely attended our meetings or contributed to our Transactions of late years, was keenly interested in the welfare of the Society and generously supported it.

Born at Sprowston Hall on October 4th, 1876, he was the second son of John Gurney. At Eton he took up biology under Mr. W. L. Sclater with the intention of making zoology the subject of his life's work, and, proceeding to Oxford, he there continued his studies under Professor Ray Lankester and took a second class in the Honours School of Zoology.

On leaving Oxford he occupied for a year the Oxford table at the Biological Station, Naples, where he carried out research on the reproduction of Ascidians, but although he wrote up the results of this work he could not be induced to offer it for publication.

In 1902 he built and equipped the Sutton Board Laboratory, the first and only freshwater Biological Station in this country. Here he began a study of the freshwater fauna of the Norfolk Broads, as a preliminary to more fundamental work on the biology of fresh water. At that time Limnology was in its infancy, and he rightly considered that the first task was a

general survey of the fauna of the region. Unfortunately the death of his brother, Nigel, in 1902, forced him to abandon a scientific career and to take up the duties and responsibilities attaching to the ownership of land.

Thorough and business-like in all that he undertook, he devoted himself whole-heartedly to the management of his estate and to public service. In 1903 he was elected on to the Board of Management of the Norfolk and Norwich Hospital, of which he was chairman on three different occasions; and in 1904, on the occasion of his marriage, he equipped an X-ray and Electro-Therapeutic department for the hospital. Since then, many other improvements have been made at the Hospital, largely as the result of his far-sightedness and generosity.

His interests were wide and active and he rendered good service on the Castle Museum Committee, the Diocesan Board of Finance (of which he was chairman), the Norfolk County Council, and the Norwich Town Council. In 1910 he was elected Lord Mayor of the City, in which year the Royal Agricultural Show was held at Crown Point. In connexion with this he received his knighthood at the hands of King George.

When the question of a War Memorial arose after the Great War Sir Eustace came forward with a scheme for a joint memorial for county and city—the formation of a College of Science and Technology in Norwich, with the ultimate foundation of a University. Although he himself offered £10,000 towards this project, it was obvious from the response that he was too far in advance of public opinion, and it was, perhaps, one of the greatest disappointments of his life that the scheme had ultimately to be abandoned.

Though unable himself to carry out scientific research, he kept closely in touch with the progress of biology, and encouraged and assisted research by others. For example, he supported for some years an investigation of Frontal Sinus disease, and the Soil Survey of Norfolk carried out by Mr. L. F. Newman and published in our Transactions (Vol. IX., p. 349) was made at his instigation and cost. He was keenly interested also in the work of the School of Agriculture, Cambridge, and he was largely responsible for the inception and maintenance of the Norfolk Experimental Farm.

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1904

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Matthew Vaughan, M.A.

He was President of this Society in 1905, and gave an address on the subject of Limnology.

He married in 1904 a daughter of the late John Lee Warner, and is survived by Lady Gurney with three sons and four daughters.

S. H. L.

MATTHEW VAUGHAN, M.A.
1854—1928

It is with deep regret that we have to record the death, on March 13th, 1928, at his home, The Limes, Marlborough, of Matthew Vaughan, who had been a member of this Society for forty-eight years.

Born at Brixton in 1854, his early boyhood was spent at Finchingfield, Essex, where his father was vicar. He was educated at Felstead and St. John's College, Cambridge, where, in 1877, he took a first class in the Classical Tripos. Quoting from an appreciation in the "Times," it may be said that "his life's work was done at Haileybury, where he remained from 1878 to 1910, and was Housemaster of Edmonstone from 1883 to 1898. As a schoolmaster he was of the best type of the old school, with a firm belief in classics and a sound method of teaching them, remarkable always for his pithy sayings, vigorous and sometimes drastic methods, and, above all, sterling honesty." He was a man of many interests, the chief of which were military history and ornithology; nor was he a stranger to the trout on the Kennet.

For many years he regularly paid visits to Norfolk for partridge and wild fowl shooting, as the guest of his fellow naturalist-sportsman, R. J. W. Purdy, at Foulsham. It was on the "muds" that he had the greatest pleasure shooting, for there he had opportunities of becoming familiar with the habits, notes and plumages of the various ducks and waders in which he was so interested. He was a first-rate field ornithologist, and many were his regrets to the writer of this notice that his field for observation work was so limited around Marlborough, where he took up his residence in 1915.

During the Great War he rendered valuable services. To release younger members of the staff he acted as a "dug-out," as he described himself, at Marlborough College; he assisted

in food production and worked unremittingly as a member of the local War Savings Committee.

Although such a keen and well-informed ornithologist it was rarely that he could be induced to publish anything on the subject of birds, and only twice did he contribute to our Transactions, and then only after persistent invitation from the Editor. His first paper (Vol. X., p. 107) was an account of a visit to the bird sanctuaries in Holland in 1914; and his second (Vol. XI., p. 59) an historical account of the breeding of the Black-tailed Godwit in East Anglia.

He married in 1912 the youngest daughter of General Sir George Chesney, R.E., who survives him. There must be many old Haileyburians who will cherish his memory.

"A square-set man and honest—and his eyes
An outdoor sign of all the warmth within,
Smiled with his lips."

S. L.

SIR CHARLES SISSMORE TOMES, L.D.S., F.R.C.S., LL.D, F.R.S.

1846—1928

By the death of Sir Charles Tomes, which took place in his 83rd year at Mannington Hall, Norfolk, on October 24th, 1928, this Society has lost one of its most distinguished scientific members.

Born in London in 1846, the son of Sir John Tomes, F.R.S., he was educated at Radley, and Christ Church, Oxford, and, in 1886, took a first class in the Honours School of Natural Science. He then entered at the Middlesex Hospital, from which, in 1869, he obtained the diplomas of L.D.S. and M.R.C.S. He at once began histological research work in connexion with the subject of teeth, and with such brilliant results that at the age of thirty-two he was elected a Fellow of the Royal Society, thus following in the footsteps of his distinguished father. For many years he practised as a surgeon dentist in Cavendish Square, but relinquished such work at the age of fifty. At this time he was a Vice-President of the Zoological Society and performed

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autopsies on many animals that had died in the Society's gardens. All animals had an attraction for him, but especially retrievers, and during his long life he had owned some highly intelligent and trained dogs of this breed.

He was fond of all forms of sport, and as an undergraduate, in 1865, rowed in the Trial Eights. For many years he took a grouse moor in Scotland, and it was the shooting to be obtained in Norfolk that determined him to take up his residence in the county. In 1906 he came to Mannington Hall, a seat of the Earl of Orford, often described as the most interesting moated house in the county, and here up to his death he enjoyed to the full the pleasures and advantages associated with a well-found country house. In his retirement he was never idle and gave the impression that he enjoyed every minute of his life. He was an expert photographer with both monochrome and autochrome plates, and with his trained eye for colour and a highly artistic sense he produced paintings and sketches of great merit, several of which were exhibited in the Academy and in London galleries. Among his many-sided achievements he had a highly trained musical sense and at one time derived much pleasure from part-singing as a member of the Moray Minstrels.

From 1898 to his retirement in 1920 he was the Crown nominee on the General Medical Council, of which body he was Treasurer during the last sixteen years of this time. As a recognition of the valuable work he had rendered to the Council in this capacity a knighthood was conferred upon him, in 1919.

For many years he was a member of the Board of Management of the Norfolk and Norwich Hospital and held the office of chairman in 1915. With a mind and judgment so highly trained on scientific matters he was often able to give invaluable advice to this Board. During the War he also acted as inspector of Red Cross hospitals in the county.

Sir Charles Tomes married, in 1873, a daughter of Dr. Charles Cook, of Brooklyn, U.S.A., who survives him with a daughter.

He will be held in affectionate memory by his many friends in Norfolk.

S. H. L.

JAMES EDWARDS, F.E.S.

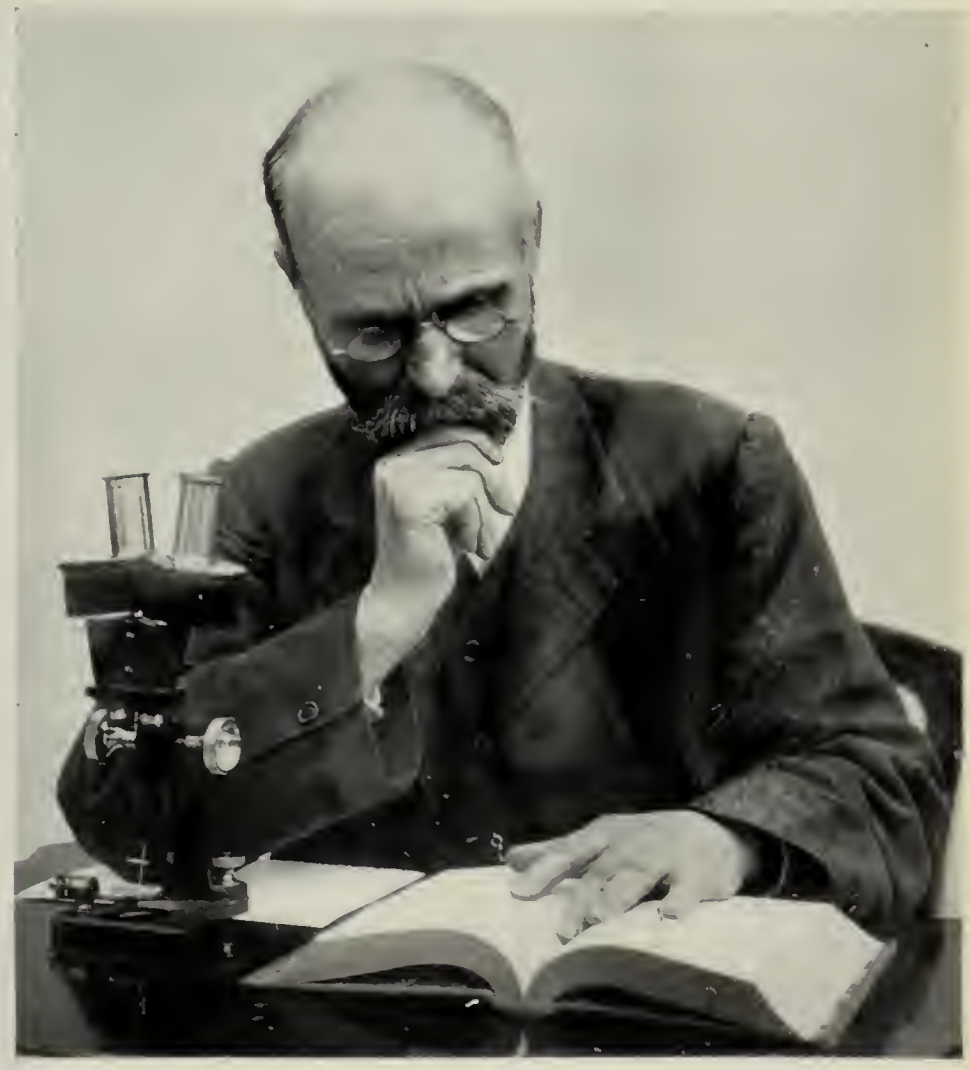
1856—1928

A DISTINGUISHED member of our Society passed away on October 13th, 1928, in the person of Mr. James Edwards, F.E.S., of Colesborne, Gloucestershire.

Mr. Edwards was born in Norwich in 1856 and was therefore seventy-two years of age. He was an entomologist from his childhood, and to the end of his days was never so happy as when collecting and studying the creeping things around him. He was employed for many years in the office of Messrs. Copeman and Ladell, of Norwich, but the atmosphere of a solicitor's office was not altogether congenial to him, and in 1891 he left the City to take the position of Curator and Secretary to the late Mr. Henry John Elwes, F.R.S., of Colesborne Park, Gloucestershire, who was then a famous naturalist and sportsman.

At Colesborne he had charge of one of the largest private collections of butterflies in this country. Associated with Mr. Elwes he did a considerable amount of research work among the more obscure families of butterflies and they published jointly several valuable monographs, the most important of which was "A Revision of the Oriental Hesperidæ" issued by the Zoological Society of London in their 1897 Transactions. On the death of Mr. Elwes in 1922 the Colesborne collections were disposed of, but Mr. Edwards remained as secretary to Colonel H. C. Elwes who inherited the estate. Although his entomological duties thus ceased, Mr. Edwards continued in his spare time his studies of the British Beetles and Homoptera. These latter were his special favourites, and he got together a collection of the various species and varieties occurring in this country which is quite unequalled, containing as it does the types of over 100 new species. He published a Text Book dealing with all the species of British Homoptera which is likely to remain the standard authority on these insects for many years to come.

Mr. Edwards was a man of unusual ability, as may be judged by the fact that although he had not the advantage of an advanced school education, as judged by modern standards, he in later life taught himself Latin and all the principal



JAMES EDWARDS, F.E.S.

European languages, thus enabling him to study his insect literature in the original text and to correspond with entomologists in all foreign countries.

Mr. Edwards was elected a member of our Society in 1877 and when resident in Norwich was a regular attendant at the Meetings. He has contributed a number of papers to our Transactions, the earliest being in 1878. He has been responsible for the Coleoptera and Hemiptera Sections in the Fauna and Flora lists published in the Transactions.

He leaves a widow, two sons, and a daughter.

H. J. T.

XII.

MISCELLANEOUS NOTES AND OBSERVATIONS

The Hawk Moth Irruption of 1927.—In August and September, 1927, there was a decided irruption of Hawk-moths, the first of any importance since 1921. The following list comprises all records that have reached me and are, with two exceptions, Norfolk captures.

Convolvulous Hawk (*Sphinx convolvuli*).—Between August 14th and 19th, Sea Palling, 1 specimen. Between August 20th and 27th. Norwich, 2 specimens. Eastbourne, 4 specimens. August 20th, Caistor, 1 specimen. August 30th, Norwich, 1 specimen.

Death's Head Hawk (*Acherontia atropos*).—Between August 14th and 19th, Sea Palling, 3 specimens. September 16th, Worthing, 1 specimen. September 22nd, Lakenham, 1 specimen. September, West Runton, 1 specimen.

In addition to the above a correspondent of the "Eastern Daily Press" reports captures of the Death's Head and Convolvulous Hawk moths at Hemsby, together with the occurrence of the Oleander Hawk (*Chœrocampa nerii*) in the same locality in 1926.—E. T. Daniels.

Crossbills.—In July, 1927, a flock of Crossbills haunted a wood four miles from Yarmouth. On the 21st an exhausted

individual alighted upon a fishing smack and was brought home alive. Nearly a score were observed at the north end of the town on the same date. One was observed on a dead apple tree apparently eating woolly American blight.

Ray's Bream.—A shoal of Ray's Bream (*Brama raii*) visited our English coasts last year. The first one of which there is a record was found on Wells Quay on November 12th, 1927. Length, 23 inches. Three or four had hitherto been recorded in Norfolk. Another was found on Cromer beach, and one at Happisburgh. Other examples were noted in Yorkshire and off the Scottish coast.

Rorqual Whale.—The decaying carcase of a Lesser Rorqual was washed up late in November, 1927, between Caistor and Scratby. It was 30 feet long and fully adult.

Food of the Herring.—In June I examined the stomach of an average-sized "mid-summer longshore" herring and found in it a Pogge (*Agonus cataphractus*) an inch-and-a-half long, as well as eight Nereid worms, each four or five inches long, and seven three-inch Lesser Sand Launces.—A. H. Patterson.

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NATURAL HISTORY.

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Ladies or Gentlemen distinguished for their attainments in Natural Science, or who have rendered valuable services to the Society, may be nominated by the General Committee as Honorary Members, and elected by a show of hands at the next meeting of the Society. Such Honorary Members have all the privileges of Ordinary Members.

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TRANSACTIONS

OF THE

Norfolk and Norwich

NATURALISTS' SOCIETY

PRESENTED TO MEMBERS FOR

1928–29

VOL. XII.—PART V

EDITED BY THE HONORARY SECRETARY

NORWICH

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DECEMBER, 1929

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1. The practical study of Natural Science.

2. The protection, by its influence with landowners and others, of indigenous species requiring protection, and the circulation of information which may dispel prejudices leading to their destruction.

3. The discouragement of the practice of destroying the rarer species of birds that occasionally visit the County, and of exterminating rare plants in their native localities.

4. The record of facts and traditions connected with the habits, distribution, and former abundance or otherwise of animals and plants which have become extinct in the County ; and the use of all legitimate means to prevent the extermination of existing species, more especially those known to be diminishing in numbers.

5. The publication of Papers on Natural History contributed to the Society, especially such as relate to the County of Norfolk.

6. The facilitating of a friendly intercourse between local Naturalists by means of Meetings for the reading and discussion of papers and for the exhibition of specimens, supplemented by Field-meetings and Excursions, with a view of extending the study of Natural Science on a sound and systematic basis.

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1925 Busittil F. P., Swardeston, Norwich
1900 Bussey A., Wayford, Stalham
1926 Butler S., Lime Grove, Lime Tree Road, Norwich
1921 *Buxton Anthony, Knighton, Buckhurst Hill, Essex
1884 Buxton A. F., Fairhill, Tonbridge
1923 *Buxton Major Ivor, Little Dunham, King's Lynn
1906 Buxton R. G., Petygards, Swaffham, Norfolk
1929 Buxton R. J., Sawbridgeworth, Herts.
1906 Buxton W. L., Bolwick Hall, Marsham, Norwich

C

1909 Calvert E. M., Eaton, Norwich
1925 Canterbury Viscount, Bergh Apton, Norwich
1923 Carruthers Douglas, Barmer Hall, King's Lynn
1907 Caton Rev. R. B., Great Fakenham Rectory, Thetford
1902 Cator John, Woodbastwick Hall, Norfolk
1923 Cator H. J., Ranworth Old Hall, Norwich
1922 Cator Miss Diana, Trewsbury, Cirencester
1926 Chadwick Dr. M., 3, King Street, King's Lynn
1911 Chamberlin Rev. C. M., Witton Rectory, Norwich
1924 Chambers Miss M. H., 72, Ditchling Road, Brighton
1929 Chapman F. S., St. John's College, Cambridge
1925 Charlesworth J. B., Gunton Hall, Lowestoft
1919 *Chasen F. N., The Raffles Museum, Singapore
1924 Chittock A. T., 12, Chapel Field North, Norwich
1924 Chittock Mrs. A. T., 12 Chapel Field North, Norwich
1907 Christie J. A., M.P., Framingham Manor, Norwich
1923 Citters A. van, Broadlands, Wroxham
1925 Clarke Mrs. F., "Coniston," Newmarket Road, Norwich
1927 Clarke Miss L. R., 12, St. Philip's Road, Norwich
1911 Cleather Rev. W. S., Barningham Rectory, Norfolk
1923 Clodd Mrs., Strafford House, Aldeburgh, Suffolk
1925 Cobbold J. D., Holy Wells, Ipswich
1909 Coke Right Hon. Viscount, Holkham, Norfolk
1923 Cole Lowry A. C., The Lodge, Sprowston
1923 Cole Mrs. Lowry, The Lodge, Sprowston
1923 Collin J. F., 419, Unthank Road, Norwich

Elected.

1924 Collings Dr. D. W., The Mount, Southwold
1921 Colman Capt. G. R. R., Framingham Hall, Norwich
1903 *Colman Miss E. M., Carrow Abbey, Norwich
1903 *Colman Miss H. C., Carrow Abbey, Norwich
1881 Colman Russell J., Crown Point, Norwich
1925 Cook G. J., 143, Newmarket Road, Norwich
1925 Copeman T. D., The Warren, Reedham
1919 Copeman W. O., 76, Highland Road, Norwich
1923 Coward T. A., M.Sc., Brentwood, Bowdon, Cheshire
1921 Cozens-Hardy A., Oak Lodge, Sprowston, Norwich
1926 Cozens-Hardy E. W., Oak Lodge, Sprowston
1886 Cross J. M., Acle
1928 Cranage Mrs., The Deanery, Norwich
1926 Cruickshank W. G., 11, Hammersmith Terrace, London, W.C.6

D

1910 Dalby Rev. Alan, M.A., The Vicarage, Leamington-Hastings, Rugby
1922 Dallas Chas. C., Eastley Wootton, New Milton, Hants.
1928 Daniels E. T., 31, Market Place, Norwich
1923 Daukes Maj. A. H., 22, Egerton Terrace, London, S.W. 2
1920 Davey Guy, Aldborough, Norwich
1927 Davies, Miss H., Branksome Road Norwich
1914 Davies H. C., Old Lakenham, Norwich
1901 Day Donald D., F.R.C.S., All Saints' Green, Norwich
1926 Day, J. Wentworth, 61a, Pall Mall, London, S.W.1
1917 Deacon G. E., Brundall, Norwich
1928 Dewing B., Point House, Aylsham Road, Norwich
1891 Digby A., Syderstone, King's Lynn
1916 Doughty Chester G., 7, Upper Cliff Road, Gorleston-on-Sea

E

1911 Easter W. C., 99, City Road, Norwich
1924 Elliott T. B., 8, Brunswick Road, Norwich
1929 Ellis Edward, 84, Springfield Road, Gorleston
1897 Evans H. Muir, M.D., Turret House, South Lowestoft
1919 Evans-Lombe Major E., Marlingford Hall, Norwich

F

1885 Falcon Michael, Sprowston Hall, Norfolk
1927 Fawkes, Dr. R. B., Rede's House, Cromer
1922 *Ferrier Miss J. M., M.B.O.U., Hemsby Hall, Norfolk
1922 Ferrier R. F. E., F.S.A., Hemsby Hall, Norfolk
1924 Fisher K., The School, Oundle, Northants
1923 Fisher Sidney, Oaklands, St. Clement's Hill, Norwich
1924 Fleming James M., " Drumwalt," The Long Road, Cambridge
1880 *Fletcher W. H. B., Aldwick Manse, Bognor
1922 Fonnereau Miss Hilda, The Eyrie, Palling, Norfolk
1924 Fowler Major E., Gunton Old Hall, Lowestoft
1924 Fowler Miss E., Drinkstone House, Bury St. Edmbuds
1922 Frere Sir Bartle H. T., South Walsham Hall, Norfolk
1926 Fuller A. W., 18, Kerrison Road, Norwich

G

1927 Garnett R. M., Pudding Lane Cottage, Kelling, Norfolk
1902 Garstang Walter, D.Sc., The University, Leeds
1924 Gay Miss Ellen, Thurning Hall, Guist, Norfolk
1927 Gay Miss C. E., Ardleigh House, Hornchurch, Essex

Elected.

1925 Gay Miss G. A., Ardleigh House, Hornchurch, Essex
1926 Gayner J. S., Hall Cottage, New Earswick, York
1922 Gaze R., 105, Earlham Road, Norwich
1903 Geldart Miss Alice M., Cotman Road, Norwich
1928 George Sydney S., Saham Toney, Thetford
1929 Gifford J., 251, College Road, Norwich
1926 Gilbert Brig.-Gen. A. R., C.B.E., D.S.O., Sprats Green, Aylsham
1926 Gilbert Mrs. A. R., Sprats Green, Aylsham
1908 Gilbert R. T. E., Ashby Hall, Norfolk
1923 Gill S. T., Rupert Street, Norwich
1921 Glover T., 224, Unthank Road, Norwich
1909 Goodchild Herbert, The Chestnuts, Unthank Road, Norwich
1901 Goose A. W., 10, Sandringham Road, Norwich
1922 Gossage Mrs., Leet Hill, Kirby Cane, Norfolk
1922 Gossage Col. W. W., Leet Hill, Kirby Cane, Norfolk
1927 Grant E. R., Hotel Roosevelt, Washington, D.C., U.S.A.
1921 Graves Mrs., Oulton Lodge, Aylsham, Norfolk
1919 Greatorex H. A., Witton, Norwich
1924 Green Maj. E. A. Lycett, Ashfield, York
1918 Gresham School The, Holt, Norfolk
1913 *Grey of Fallodon, The Rt. Hon. Viscount, K.G., P.C., Fallodon, Lestbury, Northumberland
1926 Gunn F. E., 84, St. Giles Street, Norwich
1918 Gurney Major Cecil F., Berry Hall, Walsingham
1893 *Gurney Gerard H., F.Z.S., Keswick Hall, Norwich
1929 Gurney John, Walsingham Abbey, Norfolk
1901 Gurney Q. E., Bawdeswell Hall, Norfolk
1894 *Gurney Robert, D.Sc., F.L.S., Bayworth Corner, Boars Hill, Oxford
1918 Gurney Mrs. Robert, Bayworth Corner, Boars Hill, Oxford

H

1924 Hadfield Travers, Stoneleigh, Knutsford, Cheshire
1892 *Haigh G. H. Caton, Grainsby Hall, Great Grimsby
1905 Halls H. H., 130, Hall Road, Norwich
1926 Hammond C. R. A., Sprowston Grange, Norwich
1906 *Hamond Major Philip, D.S.O., Morston, Holt, Norfolk
1928 Hardinge Lt.-Col. T. S. N., D.S.O., Flaxmoor, Caston, Attleboro'
1919 Harker Miss Sylvia, Blofield Hall, Norwich
1908 Harker William, Blofield Hall, Norwich
1923 Harmer Russell T., The Grange, Rackheath, Norwich
1881 *Harmer Sir Sidney, K.B.E., F.R.S., V.P., The Old Manor House, Melbourn, near Royston, Herts.
1906 Harris Rev. G. H., Acock's Green Vicarage, Birmingham
1925 Hartcup Miss, Dial House, Cathedral Close, Norwich
1929 Harvard C. E., Whalebone House, Buxhall, Nr. Stowmarket
1923 Hastings Lord, Melton Constable Park, Norfolk
1925 Hemingway P. H., Bureside, Wroxham
1928 Hendy E. W., Holt Anstiss, Porlock, Somerset
1926 Herbert E. G., Braken How, Sheringham
1925 Hewitt H. Dixon, F.I.C., 25, Croxton Road, Thetford
1925 Heywood R., Pentney House, Narborough, Norfolk
1923 Hibberd Rev. H., Burnham Thorpe Rectory, King's Lynn
1919 Hinde Dr. E. B., 31, Mount Pleasant, Norwich
1891 Hinde F. C., *Hon. Librarian*, Oaklands House, Cringleford Norwich
1923 Hines E. S., 10, Parker Road, Norwich
1915 Hitchcock Arthur, Tamworth House, Tennyson Road, King's Lynn

Elected.

1921 Hoare Miss Marjorie, 17, Camberley Road, Norwich
1919 Horsfall Charles, Stody Lodge, Melton Constable, Norfolk
1923 Hoskins Maj. Gen. Sir Reginald, Philip Stott College, Overstone Park, Northampton
1919 Howard H. J., 6, College Road, Norwich
1926 Howlett J. K., The Beeches, East Dereham
1927 Hudson Lt.-Col. P., C.M.G., D.S.O., Martincross, Sheringham
1929 Hudson Mrs., Martincross, Sheringham
1923 Hunter Miss E. M., Mattishall Hall, East Dereham
1923 Hunter H. M., Mattishall Hall, East Dereham
1899 Hurrell H., 25, Regent Street, Gt. Yarmouth
1915 Hutchinson Donald, M.D., 2, Gordon Road, Lowestoft
1929 Hyslop Brig.-Gen., H. G., D.S.O., Littlewood House, Drayton, Norwich
1929 Hyslop A. B., Burnham Norton, King's Lynn
1929 Hyslop Mrs., Littlewood House, Drayton, Norwich

J

1921 Jarrold T. H. C., Pine Banks, Thorpe St. Andrew
1891 Jarrold W. T. F., Beeston St. Andrew, Norwich
1927 Jessopp A. L., Lexham Hall, King's Lynn
1926 Jolly Ll. B., Aylmerton Hall, Norfolk
1923 Jolly T. L., Manor House, Worstead
1885 Jones Sir Lawrence, Bart., 39, Harrington Gardens, London, S.W., 7.
1926 Jourdain Rev. F. C. R., Laverstock, 13, Belle View Road, Southbourne, Bournemouth

K

1926 Keith E. C., Swanton Morley House, East Dereham
1927 Kendall O. D., Dept. of Geography, University of Bristol
1929 Ker Mrs. Rait, 42, Parkside, Cambridge
1897 Kerrison Colonel E. R. A., C.M.G., D.L , Burgh Hall, Aylsham, Norfolk
1925 Kerrison Mrs., Burgh Hall, Aylsham, Norfolk
1912 Ketton-Cremer W. C., Felbrigg Hall, Norfolk
1926 Kimberly Mrs., M.Sc., "Constantia," Elm Grove Lane, Norwich
1904 Kinder Rev. E. H., Kirby Bedon Rectory, Norfolk
1898 Knight Edward, Keswick Old Hall, Norwich

L

1925 Labouchere P., The Lodge, Burnham Thorpe, King's Lynn
1926 Lane D. H., Framingham Pigot, Norwich
1929 Lawrence F. J., Lauriston, Mossell River, Harmanus, Cape Province, S. Africa
1926 Leconfield Lady, Petworth House, Petworth, Sussex
1921 le Strange C., Hunstanton Hall
1909 Leicester The Right Hon. the Earl of, G.C.V.O., C.M.G., *V.P* Holkham
1899 Leney F., Castle Museum, Norwich
1927 Lister Dr. S. R., Terrington Lodge, King's Lynn
1921 Lucas Baroness, Horsey Hall, Norfolk

Elected.

1923 Livesay Surg. Cap. R.N., St. Andrew's Hospital, Thorpe, Norwich
1922 Livesay Mrs., St. Andrew's Hospital, Thorpe St. Andrew
1922 Lloyd Capt. L., Taverham Mill, Norwich
1925 Lloyd Mrs., Taverham Mill, Norwich
1899 Long S. H., M.D., F.Z.S., M.B.O.U., *Hon. Sec.*, 31, Surrey Street, Norwich
1907 Long Mrs. S. H., 31, Surrey Street, Norwich
1919 *Long Miss E. M., 31, Surrey Street, Norwich
1923 Long G. S. B., St. Giles Plain, Norwich
1928 Lotbinière Mrs. Joly de, Brandon Hall, Suffolk
1925 Luddington Miss, Wallington Hall, King's Lynn

M

1924 MacKenzie Miss G., The Cottage, Ingworth, Norwich
1923 *Macpherson A. Holte, 21, Campden Hill Square, Kensington, W.8
1905 Mann Sir Edward, Bart., Thelveton Hall, Norfolk
1906 Marriott F. W. P., 11, Queen Street, Norwich
1892 Marsham Major H. S., Rippon Hall, Marsham, Norfolk
1912 Mason A., Bank Plain, Norwich
1911 Master George, M.D., Bury St. Edmunds
1926 Matthews H. Whitlingham
1893 Mayfield A., F.L.S., Mendlesham, Stowmarket
1926 McCall C. Home, Upper Flat, San José, Mount Rd., Hastings
1922 McKenna Mrs. Reginald, 36, Smith Square, Westminster, S.W. 1.
1926 McLean Colin, Humbletoft, East Dereham
1926 Meade Miss P., Croxton, Thetford
1898 Meade-Waldo Edmund G. B., Stonewall Park, Edenbridge, Kent
1928 Mileham J., Aylsham, Norwich
1928 Mileham Mrs., Aylsham, Norwich
1877 Miller Henry, Bosmere House, Norwich Road, Ipswich
1923 Minns Mrs. E., Hammond's Wood, Frensham, Surrey
1923 Moppe Lewis E. van, Cliffside, Overstrand
1928 Morel Mrs., Burnley Hall, Martham, Norfolk
1929 Morley C., Monk's Soham House, near Framlingham, Suffolk
1924 Mortimer Ernest, The Red House, Wrentham, Suffolk
1922 Mountfield Miss M., 29, The Close, Norwich
1919 Moxey Llewellyn, Framingham Hall, Norwich
1920 *Mullens Major W. H., Westfield Place, Battle, Sussex
1921 *Murton Mrs., Cranbrook Lodge, Kent

N

1904 Napier A. J., *Hon Mem.*, Braes, St. Mawes, Cornwall
1926 Nash J. E., 93, Priory Park Road, Kilburn, N.W. 6
1922 Nevill Rev. R. W., Old Catton Vicarage, Norwich
1926 Nevill Mrs. R. W. .. ..
1925 Neville Sir R. J. N., M.P., Sloley Hall, Norfolk
1911 Newman L. F., St. Catherine's College, Cambridge
1889 Nicholson W. A., *Hon. Mem.*, 5, Mill Hill Road, Norwich
1915 Nightingale S. R., Scratby Hall, Great Yarmouth
1926 Norfolk and Norwich Library, Norwich
1919 Norgate Philip, Swanington, Norfolk
1915 Norwich Public Library
1927 Notcutt R. F., Woodbridge

Elected.

O

1927 O'Donnell O., Great Fransham, East Dereham
1921 Offord Miss Georgina, "The Larks," Water Lane, Costessey
1914 Oliver F. W., D.Sc., F.R.S., *Hon. Mem.*, *V.P.*, Blakeney Point, Morston, Blakeney
1924 Orgill Miss M. A., Garboldisham, Diss

P

1889 Page G. W., Walsingham, Norfolk
1919 Pain Percy, Dersingham, King's Lynn
1913 Paine Rev. N. W., Great Melton Rectory, Norfolk
1919 *Palmer Mrs. P. Hurry, "Red Roofs," North Drive, Great Yarmouth
1926 Pank A. H., Bedford Street, Norwich
1912 Parker H., 10, Aspland Road, Norwich
1925 Parker Miss Molly Hyde, Smeetham Hall, Sudbury, Suffolk
1921 Parker R. E., Marlingford, Norwich
1883 *Parkin Thomas, M.A., F.Z.S., High Wickham, Hastings
1873 Partridge Rev. W. H., M.A., "Breccles," Sandown, I. of W.
1889 Patterson Arthur H., *Hon. Mem.*, Ibis House, Lichfield Road, Gt. Yarmouth
1920 Patteson Mrs. F. E., Great Hautbois House, Norfolk
1901 *Paul J. J. Dawson, Eaton Grove, Norwich
1911 *Payler Donald, The Museum, Birmingham
1923 Peed John, Aylsham
1928 Penrose F. G., M.D., "Woodbury," 9, Grove Road, East Cliff, Bournemouth
1926 Percy Lord William, Catfield Hall, Norwich
1903 Petre Col. B., Westwick Hall, Norfolk
1925 Petrie Mrs., The Dower House, Heydon, Norwich
1926 Phillippo G., 7, St. Philip's Road, Norwich
1925 Pilch R. G., 45, Grosvenor Road, Norwich
1923 Pope Dr. G. Stevens, Heigham Hall, Norwich
1880 Preston A. W., F.R.Met.Soc., 371, Unthank Road, Norwich
1919 Preston Sir E., Bart., Beeston Hall, Norwich
1900 Preston F., 66, The Close, Norwich
1913 Purdy T. W., Woodgate, Aylsham
1925 Purnell Mrs. Ralph, 9, The Crescent, Norwich
1925 Purnell Ralph, 9, The Crescent, Norwich
1887 Pycraft W. P., A.L.S., F.Z.S., British Museum (Natural History), London, S.W.

R

1929 Ramage H. P., Ridgemont, Carrow Hill, Norwich
1928 Raywood W., 13, Upper King Street, Norwich
1925 Reeves Hugh, Honingham Hall, Norwich
1924 Richmond H. W., F.R.S., King's College, Cambridge
1925 Ringrose B., Farley, Harbridge Green, Ringwood, Hants.
1924 Rippingall Neale F., Crabbe, Weighton S.O., Norfolk
1911 Rising A. P., The Manor House, Ormesby, Great Yarmouth
1908 Riviere B. B., F.R.C.S., F.Z.S., M.B.O.U., Hill House, Saxlingham, Norwich
1869 O.M. Robinson H. S., Mundesley, Norfolk
1908 Rogers Commander F. S., R.N., Ingham New Hall, Norwich
1909 Rogers Rev. Henry, Coltishall Hall, Norwich
1908 *Rothermere Rt. Hon. Lord, Hemsted Park, Cranbrook, Kent
1897 *Rothschild Rt. Hon. Lord, F.Z.S., Tring, Herts.
1922 Rounce G. H., The Pines, Park Road, Cromer

Elected

1918 Rudd A. J., F.Z.S., Queen Street, Norwich
1902 *Ruggles-Brice Mrs. R., Keswick Hall, Norwich
1906 Rumbelow P. E., 27, Rodney Road, Great Yarmouth

S

1929 Sainty Miss O., 38, College Road, Norwich
1925 Sewell P. E., Dudwick House, Buxton, Norwich
1925 Sexton K. F., 156, Newmarket Road, Norwich
1929 Shaw A., Bixley, Norwich
1922 Shepheard Dr. Samuel, Aylsham
1924 Shepherd Miss A. M., Convalescent Home, Lowestoft
1921 Silcock Chas., Decoy Cottage, Hoveton, Norwich
1926 Slater, B. M., "Bassenhill," Corton, Lowestoft
1919 Smith Col. H. F., Didlington Hall, Norfolk
1915 Smith Mrs., Ellingham Hall, Bungay
1891 Smith W. R., Harleston, Norfolk
1917 Sowels Miss, The Rookery, Thetford
1922 Spalding G., 9 ,St Stephen's Street, Norwich
1911 Spurrell J. T., Manor House, Newton St. Faiths, Norwich
1923 Spurrell Miss M., Manor House, Newton St. Faith's, Norwich
1923 Spurrell Miss P., Manor House, Newton St. Faith's, Norwich
1925 Steers J. A., St. Catharine's College, Cambridge
1921 Stimpson Edward, Sall Moor Hall, Reepham, Norfolk
1927 Stourton Hon. J., Cawston Manor, Norwich
1922 Sumpter Dr. B. G., Brancaster Staithe, King's Lynn
1896 Sutton W. Lincolne, F.I.C., Eaton, Norwich

T

1921 Taylor Dr. Mark R., 338, Winchester Road, Southampton
1878 Taylor Shephard T., M.B., The Mount, Edgefield, Melton Constable
1921 Thain D., West Somerton, Norfolk
1886 Thouless H. J., "Southernhay," Wroxham
1924 Thursby-Pelham Miss D., Fisheries Laboratory, Lowestoft
1929 Tillett Miss I., 2, Claremont Road, Norwich
1896 Tillett Wilfrid S., 2, Claremont Road, Norwich
1920 Todd Lt.-Col. Eardley, Mundham House, Brooke
1902 Todd R. A., B.Sc., The Retreat, Elburton, Plymouth
1923 Tomes Lady, Mannington Hall, Norfolk
1910 Tracy N., 3 King Street, King's Lynn
1925 Tucker B. W., 9, Marston Ferry Road, Oxford
1906 Turner Miss E. L., F.L.S., H.M B.O.U., *Hon. Mem.*, 13, Storey's Way Cambridge
1927 Turner Edgar, "Kuruman," Walberswick

U

1923 Upcher Rev. E. C. S., Great Dunham Rectory, Norfolk
1921 Upcher H. E. S., The Gables, Upper Sheringham

V

1917 Vincent James, Hickling, Norfolk

W

1921 Wallis Rev. M. C.,
1923 Walter Mrs. Cyril, Old House, Drayton, Norwich
1921 Walton Miss, 17, Camberley Road, Norwich

Elected

1923 Waterfield Miss, Attlebridge, Norfolk
1923 Waterfield Miss Penelope, Attlebridge, Norfolk
1928 Watson J. B., c/o Barclays Bank Ltd., Surbiton, Surrey
1926 Wemys Major, " Bryn coed," Wroxham
1927 Wemys Mrs. ,, ,,
1923 Wenn Miss, Ingham, Norfolk
1883 *Whitaker Joseph, F.Z.S., Rainworth Lodge, Mansfield
1928 Whitwell Miss, 1, Cambridge Street, Norwich
1922 Willett W. L., Paddock Wood, Kent
1913 Williams Miss Margaret, 28, The Close, Norwich
1929 Wilson Mrs. Gerald, Saxlingham Nethergate, Norwich
1909 Witherby H. F., M.B.E., F.Z.S., *President*, 326, High Holborn, W.C
1924 Wolsey Noel G., 15, King Street, Great Yarmouth
1928 Wood M. S., M.D., Woodland House, Windermere
1923 Woolsey G. E. W., Old Catton, Norwich
1907 Wormald Hugh, M.B.O.U., Heathfield, East Dereham
1922 Wortley Francis, " Seathwaite," Sheringham
1929 Wortley Roger, " Seathwaite," Sheringham
1924 Wright B. D. Z., Hoveton St. John, Norwich
1920 Wyllys Hugh, " Shrublands," Southtown, Great Yarmouth

Y

1915 Yarmouth Free Library, The, Great Yarmouth

TOTAL

Honorary Members	... ...	4
Life ,,	... ...	29
Ordinary ,,	... ...	368
		401

The Treasurer in Account with the Norfolk and Norwich Naturalists' Society, Year Ending April, 1929

I. GENERAL ACCOUNT

1928–29. Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance on Current Account 80 0 11				By "Transactions," Vol. xii., Part iv....	140	8	6
,, ,, Deposit ,, ... 22 5 3				,, W.B.P.F. Re-fund of two subscriptions	5	5	0
	102	6	2	,, Postages	1	4	4
,, Subscriptions	171	14	0	,, Printing	4	1	6
,, Sale of "Transactions"	4	8	0	,, Book-binding	2	11	6
,, ,, "Flora of Norfolk"	3	4	6	,, Books	3	7	0
,, Interest on War Stock	11	7	8	,, Expenses of Meetings	5	0	0
,, ,, Deposit a/c	1	1	6	,, Fire Insurance	0	13	6
,, Publication Fund	2	6	0	,, Excursion Secretary...	2	8	6
,, Excursion Tickets	2	9	6	,, Purchase of £75 4 per cent. Consolidated Stock	66	9	7
,, Book-binding Account over-paid and refunded	2	11	6	,, Balance on Current a c	46	12	8
				,, ,, Deposit a c	23	6	9
	£301	8	10		£301	8	10

Examined and found Correct,
W. A. NICHOLSON,
June 14, 1929

BRITISH MUSEUM
25 FEB 30

II. SPECIAL PUBLICATION FUND

1928-29.	£	s.	d.		£	s.	d.
To Donations—							
F. A. Partridge		10	0				
R. C. Bell		5	0				
S. Butler		10	0				
Dr. B. G. Sumpter	1	1	0				
	£2	6	0				
				Transferred to General Account	2	6	0
					£2	6	0

III. LIFE MEMBERSHIP FUND

1928–29.	£	s.	d.		£	s.	d.
To Balance in Savings Bank	21	8	8				
„ Interest on Bank Account		14	2				
„ Interest on War Loan	2	10	0				
	£24	12	10				
				By Balance in Savings Bank	24	12	10
					£24	12	10

List of Investments and Assets

	£	s.	d.
£155 6s. 10d. 5 per cent. War Stock 1929–47, at cost	150	18	1
64 War Savings Certificates, dated 24.1.19	64	0	0
31 War Savings Certificates, dated 17.7.23. at cost	24	16	0
£191 1s. 10d., 4 per cent. Consolidated Stock, at cost	166	9	7
Balance in Savings Bank	24	12	10
	£430	16	6

ADDRESS

Read by the President, H. F. Witherby, M.B.E., F.Z.S., M.B.O.U., *Honorary Fellow American Ornithologists' Union, to the members of the Norfolk and Norwich Naturalists' Society, at their Sixtieth Annual Meeting, held at the Castle Museum on April* 30th, 1929.

Ladies and Gentlemen,

As my term of office as President terminates to-day I take this opportunity of expressing my regret that I have been unable to attend more of the meetings. These have been held monthly during the session, and, so I am informed, have been well attended. Valuable papers have been read, and these will be published in the next number of our Transactions.

Two Excursions were made during the year: one to Scolt Head Island, in July, in which about 60 members joined; the other, in August, to Keswick Hall, as the guests of Mr. Gerard Gurney, whom you have just elected as your new President.

As regards our membership, there has been a drop of four in our numbers, due to a heavy toll of death whereby we have lost the following, amongst whom were some of our oldest members:—

Dr. S. H. Burton
Mr. E. G. Buxton
Mr. G. F. Buxton
Mr. H. Donnison
Dr. Alexander Hill, F.R.S.
Sir Alfred Jodrell, Bart.
Mrs. Russwurm
Mr. Walter Rye
Mr. A. A. Shields
Mr. Edward Wild

It would be invidious for me to particularise among these honoured names, but I am sure I am voicing your feelings in saying that it is with deep regret that we have to record the loss of these members.

As to our financial position, I think this may be considered to be satisfactory. And in this connexion I would like the Society to record its appreciation of the valuable services rendered to us by Dr. Robert Gurney during the years (1915-28 inclusive) that he has undertaken the duties of

Honorary Treasurer of the Society. When he took over these duties in 1915 the invested funds of the Society amounted to £53; according to our last balance sheet they amounted to £361. I think this is good evidence of the care with which he has looked after and husbanded our resources, and we tender to him grateful thanks.

I will now proceed to read my address, which I have entitled,

A GUIDE TO SOME ORNITHOLOGICAL WORK

In my capacity as editor of "British Birds" as well as in other connexions I have often been struck by the very casual nature of many observations. The would-be observer, however keen, frequently goes out with no definite objects and quite insufficiently prepared to take full advantage of what he chances to see. No doubt this applies chiefly to beginners, but there are many others, who, I feel sure, would be doing much more valuable work by applying themselves to some definite subject and making that the first object of their observations. It is with the idea of directing attention to subjects for observation and giving a wide field of choice that I have drawn up this "Guide." A second point which I have had in mind, which is especially applicable to a Natural History Society, is the question of co-operative observation. This method requires careful organization and direction and could achieve results not obtainable in any other way. It has such great possibilities that means to exploit it should be very carefully considered by every Naturalists' Society.

In compiling this "Guide" I have endeavoured to draw attention to all main points, but I do not of course claim that it is in any way complete. I have had the advantage of discussing the subject with several friends and desire to express my indebtedness especially to the Rev. F. C. R. Jourdain, Mr. E. M. Nicholson, Dr. A. Landsborough Thomson and Dr. B. B. Riviere for criticisms and suggestions. I should greatly appreciate any further advice from those interested in the subject on any of the points dealt with or on any matters omitted. To keep the paper within limits I have refrained as a rule from giving illustrative examples, while most of the questions raised are capable of being discussed in much greater detail.

To make the address easier for reference I have divided it into sections, the first of which concerns :—

Distribution

Perhaps the first duty of a local natural history society is to study and record with exactness and in detail the distribution of the fauna and flora within its boundaries. Norfolk has for many years been fortunate in having a notable band of naturalists and has been well to the fore in this phase of study. Notwithstanding, there is still much work to be done under this heading so far as birds are concerned not only in Norfolk but everywhere. In recent years the best ornithological observations have undoubtedly increased in value by their quality, but owing to the greater number of observers and greater facilities for publication more indifferent observations are recorded. It cannot be too strongly impressed upon beginners that any observation to be of real value must be carried out with scrupulous care and exactness and in detail. Beginners seldom realize for instance, the great difficulties of correct identification of birds they have never seen before and they seldom take the trouble to prove their identification by noting down essential characteristics. Correct identification is the first essential in all observation and an uncertain identification is usually of small value. Notes written down on the spot are of the utmost importance. Practice and training are necessary for all kinds of observation, and a very good course to take would be to note the exact distribution and status of all the birds, both species and individuals, in a very small area. Such work has not been sufficiently done. I may point to a paper by H. G. and C. J. Alexander "On a Plan of mapping Migratory Birds in their nesting areas" (*Brit. Birds* II, p. 322) as an example. This plan of mapping could be adopted for the breeding species in a limited area, while careful notes could be taken of visitors at other seasons. Such exact and detailed records of distribution if combined with full notes on environmental conditions taken over a series of years are much required. They would lead us to a better knowledge of many important questions connected with Distribution in its broad sense.

We must not be content merely to discover and record the exact status of a bird. We must learn what relation birds have to each other and to all other animals ; which are dominant and which secondary species in a given area ; to what extent they are associated with a particular type of environment and what effect changes, whether natural or controlled by man, have upon them ; their density of numbers and the nature and extent of their fluctuations in relation to their environment ; the causes of irruptions ; the effects of climate and food supply whether animal or vegetable ; the meaning of the colonization of new areas and the desertion of old, and many other points which such an ecological enquiry suggests. While we know now a great deal about the distribution of species and subspecies in a general way, the study of distribution in relation to environment and all that implies is still in its infancy. Botanists have gone much farther in this direction than ornithologists and we have the advantage in this society of the experience of the admirable work done by Professor Oliver and his assistants on Blakeney Point. It would be possible for ornithological members with the help of fellow members specializing in other branches of natural science to take very small areas in different types of country and study them intensively. I would especially recommend as of great importance at the present time, an ecological study of the districts now being or about to be re-afforested in West Norfolk.

Such studies will undoubtedly throw much light on the whys and wherefores of the distribution and dispersal of birds and may lead us eventually to a better understanding of the processes of evolution and of the inter-relation between distribution and migration.

Another form of enquiry in connexion with distribution which will certainly lead to very valuable results, is to organize a census of one species over a wide area, as was done with considerable success last year through *British Birds* for the Heron, and as has been done in various counties for the Rook and Black-headed Gull. Although there are not very many species which can be dealt with by this method with any real hope of success, it may be possible in the future, with an increase in observers which we may hope for, to undertake more than seems likely now.

Besides periodical fluctuations there is little doubt that there are some species which are increasing while others are slowly disappearing in certain areas. If we had an accurate census of birds in Norfolk alone every 100 years we should probably be faced with some astonishing results. We get occasional glimpses of the truth from old lists of vermin, game and items for feasts and from other similar sources, but there are changes going on under our eyes which are not striking, and are not sufficiently recorded but are, nevertheless, important. Among examples in which more obvious changes are now going on may be mentioned Starling, Woodlark, Redstart, certain Ducks and Gulls, Fulmar Petrel, Corncrake and Blackgame.

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Phenology

The recording of the dates each year of certain recurring natural phenomena, such as the arrival of spring migrants and the flowering of plants, in relationship to each other and to the weather, should be taken up by those who are likely to be able to make the same set of observations year after year in the same place. The value of such records lies in their continuity, and we have in Norfolk a very notable example in the Phenological Record made by the Marsham family at Stratton Strawless and Rippon Hall, which except for two small gaps covers a period of over 190 years (see Quarterly Journal of R. Meteorological Society, January 1926).

Migration

The study of Migration must always be of great interest to Norfolk ornithologists since the county's coast provides good observation stations. Many important observations have been made at Cley, Wells and other places during the past years, but I feel that more could be done and much of interest could be learnt if several observers were to work contemporaneously and systematically in a chain of stations.

It is impossible in this paper to do more than touch on some of the points connected with so large a subject as migration, and I will here deal with practical work rather than theoretical.

Field Observations.—Under this head important work could be done, as suggested by a chain of observers working at the same time on the same lines. Small, isolated areas should be taken and the birds counted two or three times a day to record movement. Directions of arrivals and departures, if possible, should be noted. Weather recorded. Song, call-notes, gregariousness, segregation of the sexes, and whether the young migrate with the old or separately (an important point and one upon which it is most difficult to make entirely satisfactory observations), and other habits noted. Observation at night is also difficult but should be undertaken when possible, especially at lighthouses and lightships. Specimens should be collected discriminately to ascertain subspecies, condition of body (amount of fat, etc.) and absence or presence of food, sex and especially age and the condition of the organs, state of moult (if any), and other points. Feet should be examined microscopically for adhering seeds, a point of great interest in connexion with the dispersal of plants. It is also, of course, essential to collect migrants if the species cannot be otherwise determined. An uncertain identification is of no real value. We should never have known that such birds as the Yellow-breasted Bunting ever occurred in this country had they not been collected, and we shall never know how often they occur unless we go on collecting. The occurrence of such so-called rarities has many points of interest and importance in the study of migration and distribution. In this connexion, as I informed the Committee before accepting the honour of being nominated as your President, I do not agree with the present wording of our "object" No. 3, which reads " the dis-

couragement of the practice of destroying the rarer species of birds that occasionally visit the County." This should be qualified so that it does not apply to discriminate collecting of birds on migration, such as buntings, pipits, warblers and certain waders which cannot otherwise be identified. On the other hand, it is scarcely necessary for me to point out that no ornithologist should countenance the wanton slaughter of conspicuous species such as the Spoonbill, Avocet, Golden Oriole and many other scarce migrants. Our first "object" is, quite rightly, "The Practical Study of Natural Science," and if that is to remain our first object it must be encouraged and not handicapped.

Besides coastal observations I need hardly mention that much useful work can be done by careful recording of movements inland and would point especially to the valuable data collected (especially in recent years) at Reservoirs, Sewage farms and other such places visited by migrants.

Ringing.—The accumulation of records of ringed birds has demonstrated the importance of this method as an auxiliary to migrational observations. I need not refer to the well known method of ringing nestling birds, but I should like to impress upon members the importance of systematic trapping as a means of ringing. If two or three trapping stations could be successfully worked at suitable points during the migration seasons for some years I am sure that very valuable results would eventually be obtained. To carry this out successfully would not be easy, but it is a task eminently suitable to a Society such as ours and could be carried out in conjunction with other migrational observations, such as I have indicated above, at the same stations. A small start could be made with two stations and say eight observers, two at each station for a fortnight each, and all working on a definite plan.

Systematic trapping and ringing may some day show whether individual migrants take the same routes each year and whether they winter in the same places. Some very valuable data has already been obtained in America on these points, but insufficient trapping has as yet been done here to yield results, and I sincerely hope that the members of this Society will seriously consider the possibilities of some such plan as I have suggested. Another plan for ringing specially

adapted for Norfolk would be to revive an old duck decoy or use an existing one for the purpose of ringing and releasing at least some of the ducks taken. The results already achieved by the ringing of ducks in various countries have been so important that could we find a decoy owner so generous as to allow some ringing to be undertaken, there is no doubt that valuable knowledge would be gained of the dispersal and movements of these interesting birds. If the use of a decoy is impossible perhaps some duck traps could be set up in suitable places.

The Altitude and Speed attained by birds during migration and at other times are important points which require a great deal more study. Very few definite facts are available. Special knowledge, apparatus and facilities are generally required to obtain accurate and incontestable information on these points, but some useful work could be done by comparatively simple means. For instance, data on the speed of migrants passing along the coast might be obtained by any two observers given a measured line, stop watches and a system of signals. It would be necessary, of course, to ascertain the speed and direction of the wind which are all important in determining air speed.

Although not necessarily connected with migration the relation between the weight of a bird, the area of its wing-span and the character of its flight may be mentioned here as a subject well worth the great labour which its investigation would involve.

Observations at Sea are frequently made but often without sufficient data to give them their full value. The species seen, position of ship, time of sighting, weather and wind, behaviour of the birds, direction of flight, and so on, should be noted, and even if the exact species cannot be determined a number of small Passeres seen well out at sea is an observation worth noting with all relevant data.

Before closing my remarks on migrational observations I may mention work which has been recently done in the endeavour to discover the factors which cause birds to migrate at definite seasons. Such experiments as, for instance, those conducted by Professor W. Rowan (see " On Photoperiodism, Reproductive periodicity and the Annual Migrations of Birds

and Certain Fishes, Proc. Bost. Soc. N. Hist. Vol. 38, No. 6, pp. 147—189) have possibilities and should be persisted in and enlarged in various forms by those who have the necessary facilities and training to make such experiments.

I may also mention here experiments on the faculties of orientation and homing, which have some bearing on problems connected with migration. Our member Mr. B. B. Riviere has made valuable experiments on pigeons and a few noteworthy experiments have been made by marking wild birds, releasing them at various distances and recapturing them, and these are well worth pursuing.

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Song

There is still much to be learnt about the songs and notes of birds and this can only be accomplished by careful and methodical recording. A good "ear" (though not necessarily a musical ear), enabling one to remember and distinguish differences in pitch and phrasing, is essential for this work. A satisfactory method of rendering and recording songs and notes is a great difficulty. Perhaps a description in plain, but very exact, terms helped by a certain amount of translation into syllables, with the addition of a simple system of accents and notation signs, affords the best means of those yet designed.

The relation of song to breeding activities has been perhaps

best studied, but there are many other aspects of song to be enquired into. More records for instance are required of periods of song, both as regards day and night as well as months of the year, in different localities and under varied conditions. The relation of song to food-supply, weather conditions, moult, and the feeding of young, as well as its prevalence and character in the non-breeding season (whether of resident birds or of migrants) are subjects upon which much more information is required. The period and character of the song of immature birds, variations in song of the same species in different areas, and mimicry in song are all important studies to be undertaken only by those who have first obtained an intimate knowledge of normal song and individual variations. Other points which may be mentioned are song by females and the conditions under which this occurs; song during flight or in other positions unusual in the species concerned; special actions connected with song or certain call-notes (such as raising of crest, spreading of tail, and so on); notes uttered by nestlings at various ages; and the effect upon very young birds of their parents' call or alarm notes.

Apart from vocal notes other sounds mechanically produced by birds and their significance and exact method of production may perhaps be mentioned here, such as the drumming of Snipe and Woodpeckers.

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Breeding Habits

Although more observation and careful recording has been done in recent years in this section than perhaps in any other, the subject is so large and important that the work yet to be

done may be said to be unlimited. There are so many phases to be considered under breeding habits that it will be more convenient to treat these under subsections.

Choice of Mates.—There are many problems yet to be solved in connection with this subject and this can only be done by very close observation, and careful recording of the facts observed.

Displays, nuptial flights, courting attitudes, mock fights and real fights and other such performances by birds are extremely fascinating to watch and have for long attracted much attention. but it is only in comparatively recent years that they have been studied intensively. There is still much more to be done before the exact significance of these performances can be determined. Many are of a complex nature and they often take place (perhaps in a modified form) at times and in circumstances, which do not seem to be directly concerned with pairing or breeding.

There are also many problems to be solved in connexion with polygamy and polyandry (both perhaps more frequent than at present realized); the changing of mates (see recent work by Burkitt on Robin and Baldwin on Wren by means of identification rings); pairing for life (is this an individual question or common to certain species?); the proportion of unmated birds and their influence on paired birds.

Another question of importance is, To what extent do birds become paired in their winter quarters or on migration before reaching breeding quarters? Further investigation is also needed regarding the influence which weather and changes of climate have upon pairing and breeding.

Law of Territory.—Intimately connected with the choice of mates is the choice of territory, and indeed it is often impossible in the present state of our knowledge to say whether certain displays, actions or songs, have a basis which is mainly sexual or mainly territorial. Even if we do not accept Mr. Eliot Howard's "Law of territory" in its entirety, its conception has opened up a most important and fascinating field for observation. In this connexion not only the actions of birds of the same or allied species must be noted, but the exact distance apart of nests, and the range of each pair in search of food in relation to local conditions are among the points on which many more observations are required.

Nesting Sites and Nests.—The share of the sexes in the choice of the nesting site, building of the nest, incubation and tending of the young is still uncertain or unknown in many species. It is also important to observe in those cases where only one of a pair actually builds the nest, or incubates or tends the young, the actions of the other bird whether it assists in any way or not. Variations of site are valuable to record especially in connexion with local conditions, and adaptations to altered conditions. The structure of the nest and the materials used still require more observation, while the exact method of building is seldom observed throughout in detail. Communal nesting as well as combined nests, and the inter-relationship of the birds so breeding call for more observation, as do the curious cases of multiple nests. The construction and use of "cocks' nests" is a subject that will repay further investigation, and the same may be said for nests made for the use of young and for roosting.

The return of the same birds to the same nesting site has been proved in a good many cases by ringing, but there are few facts concerning changes of nesting site by individuals. Incontrovertible facts of the kind concerning the doings of individuals are of great value. More difficult, but equally important, are observations on the occupation of certain apparently favourable sites by birds which can be proved to be different individuals of the same species.

Eggs.—Large series of observations from different localities are required on the variation in the number of eggs in the full clutch of various species before the influence of latitude, locality, climate, food-supply and so on can be determined. More information is also required as to the dates at which birds lay under varying local and climatic conditions. Other points connected with eggs which may be mentioned as requiring further study are their size and weight in relation to specific as well as to geographical variation; their weight at various stages of incubation; the inheritance of colour pattern, which might be determined in some cases (e.g. Guillemot) by systematic ringing.

Incubation and Young.—Much information has been collected in recent years regarding incubation and fledging periods, but much more is needed, and perhaps more than

ordinary care should be taken in such observations. Mr. Jourdain gives me the following points as essential to note in observations of incubation periods :—First of all the intervals between laying must be ascertained. Then the time at which steady incubation begins must be noted. Also whether the bird broods at night, before seriously incubating. Of course, one definite observation is really insufficient ; the mean of a good many from different localities is very desirable. It is a very good plan to mark the eggs as laid ; in fact this is most necessary when incubation begins before the set is complete to avoid uncertainty due to some eggs being addled. Care, however, must be taken to see that handling of the eggs does not cause temporary desertion and affect the normal incubation period. Further difficulties arise when the eggs begin to chip. This should be noted but emergence is the date required for incubation period.

Methods of feeding, carrying of the food, regurgitation, distance from which the food is brought, frequency and times of feeding besides the actual food given, sanitation and brooding are among points to observe in connexion with the care of the young. Besides the behaviour of the old birds to their young, the behaviour of the young to each other should also be observed. The growth of nestlings and their weights under varying conditions would make a valuable study, while the various stages of their plumages and colouring and growth of their soft parts are points upon which much more exact information is required.

The number of young successfully reared by individuals and species in different seasons and places, and the causes and proportion of mortality are exceedingly interesting questions, about which we know practically nothing, owing to the difficulty of making reliable observations, but close watching of particular broods, combined with ringing, might teach us more on these points. The number of broods hatched or reared by different species in different districts also requires further observation, especially in relation to local conditions such as climate, abundance or scarcity of food and so on. In this connexion care must be taken to differentiate between bona-fide cases of second or third broods and birds breeding again after the destruction or desertion of their eggs or young.

Different methods of protecting the young and the nest adopted by different species and the varying strength of the maternal instinct in various individuals and species is a subject which requires more systematic observation. Other matters connected with young birds which should be studied are habits and actions special to their age (such as means of concealment or escape, locomotion, song, feeding). The study of young birds just fledged may also give clues to the origin of impulses, which later become important—e.g., jealousy of territory, song, etc. Such actions in quite young birds are simplified and can be studied with a view to throwing light on the complex behaviour of older birds, which is so much more difficult to analyse. Further points in connexion with young birds are their transportation by the parents and the part the latter take in educating and maintaining the young after they leave the nest as well as their behaviour to the young when full grown, and, for instance, cases of earlier broods helping to bring up later ones.

Parasitism.—The only example of complete breeding parasitism in this country is the Common Cuckoo, and notwithstanding the great attention which has been paid to it in recent years and the great advance which has been made in our knowledge of its habits, there is still much to be observed. The subject is one of great biological interest and importance and a few of the points to which special attention may be directed are as follow:—methods of depositing the egg in the nests of various species; period of laying season and number of eggs; normal fosterers in a district and the resemblance or dissimilarity of the Cuckoos' eggs to those of the fosterers; the acceptance of the egg and hatching and rearing of the young by the foster; or its rejection by desertion, building over or other means; damage to covered nests by the Cuckoo and its result; the destruction of eggs or young of intended fosterers; results of the hatching of two or more Cuckoos' eggs in the same nest; territory; number of males to a female. All these points are obviously difficult of observation and knowledge of them can only be obtained gradually and laboriously.

Besides parasitic feeding habits such as those of the Skuas and less obvious and more complex examples, cases of partial-parasitism may be here mentioned as worthy of attention,

such as the use of old nests of other species, the dispossession of one bird by another of nest or nesting site, and the laying of eggs in other birds' nests.

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Dispersal and Habits of Young

Intimately connected with both distribution and migration are the habits of the young after they are fledged. How they form flocks or become dispersed, whether they migrate alone or accompanied by adults, whether they spread into new areas or return to breed in the place of their birth, are all questions of which we have some knowledge, but concerning which we want many more observations. On some of these points valuable facts are gradually being accumulated by the records of ringed birds, and there is no doubt that much more could be learned if those who ring young in the nest would combine this with trapping in the same area. There seems little doubt that different rules govern different species in the dispersal of the young. Ringing has given us an inkling that, for instance in some of the ducks, the young disperse very widely. This habit may be confined to a few species or it may be more or less an individual question, the known facts are too few to enable us to say. In the same way we do know that young birds sometimes migrate differently from old ones, but a great deal more observation is required on this point and we do not know how this may affect their dispersal. In the case of partially migratory species such as Lapwing, Song-Thrush and

many others, we do not know why some individuals migrate and others stay at home, nor whether the act of migration has any effect on the distribution of the young in future breeding seasons. Much less do we know if this habit is hereditary and constant or irregular. Systematic and continued trapping as well as ringing of the nestlings should in time give us valuable facts on these points. Here I must mention that it is important that ringers should record invariably which ringed birds are members of the same brood. In some cases of migrants, such as the Pied Flycatcher, we do not really know what are their movements after leaving the nest and before actual migration. Besides the dispersal of the very young, the distribution of the immature non-breeding birds requires further study and I shall revert to some points regarding this under the next section.

Non-Breeding Habits

There is much to be observed outside the breeding season and in non-breeding birds. Flocking habits should be studied in their various aspects, e.g., the formation and disbandment of flocks in birds which breed separately, or their alteration in communal breeding species ; the association of different species, or of different forms of the same species ; their relations to each other ; the segregation of sexes ; feeding habits of the flock ; daily movements and roosting habits ; the flight of the flock and the unexplained unison of movement, and many such questions.

The varying density of species in the same area in summer and winter and its relation to food supply or other environmental factors are points in which little systematic work has yet been done. The effect of climatic changes as well as of other environmental changes, whether in the breeding season or not, on various species in various localities has been referred to under distribution, but may be mentioned again here owing to the importance of such investigations.

There are many other subjects for study in winter (as well as summer) such as flight ; diving ; the senses of smell and taste ; sleeping places ; diseases ; mortality and ages to which birds live ; autumn and winter song and display ; breaking up of flock into pairs ; and the return of migrants.

A very important point which may be dealt with under this section is the age at which birds breed. Concerning this subject we have very little real evidence. It is certain that this often does not depend upon the assumption of the mature plumage (e.g., many hawks breed in an immature plumage), that it varies largely in different species and probably considerably in different individuals, while the influence of climate, food supply and other varying local conditions is unknown. The study of a non-breeding bird on an exact basis is difficult because, even after having discovered for certain that it is not breeding, the age of the bird can often not be ascertained, and there may be many reasons other than immaturity for its not breeding, as for instance sterility or inability to get a mate or suitable territory, or the loss of a mate. There is certainly a great deal to be learned about non-breeding birds and their migrations and movements, as well as their habits at all seasons and their influence on breeding birds, and all these points require special study.

A subject for investigation which may be referred to under this section is the mentality of birds. This requires very careful study, and to present a true picture of the bird's actions and their meaning the observer must be entirely unbiassed and free from any anthropomorphic suggestions in interpreting the behaviour observed.

Food

Most of the systematic work which has been done on the food of birds has been undertaken primarily from the economic point of view. This is a very important side of the question, and, notwithstanding Dr. Collinge's great individual effort, much further exact knowledge, drawn from a wider field, is required on the nature of the food of birds in this country before the real economic status of a species under varying local conditions can be ascertained. Moreover, such work should be continuous since changes in environmental conditions, numbers and food-habits are constantly occurring. I may mention without discussion that the merits of the volumetric and other systems of estimating economic value form a suitable subject for further investigation. In any case it would seem that an economic verdict cannot be based purely on stomach

contents by whatever method they are analyzed, and some working procedure for giving due weight to observational data in the case of rapidly digested food is certainly needed. Rate of digestion ; total consumption ; diet in relation to numbers, to quantity of available food and to competitive species must also be investigated.

The scientific aspects of the food and feeding habits of birds are of very great importance and there is here a big field awaiting exploration. It is of primary importance to ascertain the exact food taken by a species at different seasons and in different areas. Dr. Collinge has given us a basis for this, but I would point out that co-ordinated work with scientists abroad upon species of wide distribution is of great importance and has hardly been touched yet. Arising out of such knowledge a number of interesting investigations suggest themselves. For instance, what is the effect of weather on food supply ? How does this affect the periods at which birds breed ? What effect does food supply have upon fecundity, and what relation has it to the colonization of new areas or the desertion of occupied areas, and to increases and decreases in species ? Conversely, to what extent are increases or decreases a factor in altering food-habits ?

Intimately connected with these larger questions are more detailed points such as the range of different species of birds in search of food, not only in the breeding season when a return to the young with food at certain intervals is necessary, but also at other seasons where this controlling factor is absent. Other subjects for study are methods of searching for, and taking and eating, food, as well as carrying and storing it. Differences in feed and feeding habits at different times of year in the same species are also important. The exact methods used by different species in feeding the young have also been insufficiently studied. Other points connected with food requiring more experimental treatment are the ejection of pellets and gizzard linings and the possibility of change of food causing modifications in structure or diseases.

As food is of primary importance to the life of the bird and is necessarily interelated with most of its activities it is rather strange that the subject has not been more widely and intensively studied in all its bearings.

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AVICULTURE

Many bird-lovers devote their main energies to keeping birds in captivity. This is generally done merely as a pleasurable hobby, and I wish to appeal to aviculturists to make use of their experience of how to keep birds successfully in captivity by carrying out experiments and observations which would be of value scientifically. There are many possible subjects for enquiry from which the scientifically inclined aviculturist could choose according to his or her inclination and resources. I need only mention a few in order to show that the field for research is large, and I think I am justified in saying that the number of aviculturists who have occupied it is disappointingly small in comparison with the large number who keep birds in captivity merely to please themselves.

I may mention first one simple case of supposed dimorphism which could be proved directly and conclusively by aviculturists. I refer to the Black-throated and Black-eared Wheatears (*Oenanthe hispanica*) both of which have occurred in the British Islands and breed commonly as near to us as in Spain.

The majority of ornithologists have for some time considered these birds to be dimorphisms of the same species but this conclusion rests on circumstantial evidence. It is high time that some aviculturist went to Spain and having obtained broods of these birds proceeded to rear and keep them until they attained their first winter plumage. I need hardly say that it would be a highly necessary part of the experiment to collect and preserve the parent birds of each brood and ring or otherwise carefully mark the young so that they could be permanently identified as belonging to a certain brood of certain parents. The proof of dimorphism, would lie in some of the young being different from the parents or different from others of the brood and this would be apparent in the males

when they moulted from juvenile to first winter plumage. I have drawn attention to this case in some detail in the hope that aviculturists will no longer neglect the obvious duty of providing proof of the correctness or otherwise of the present view.

Most valuable work can be done by observing the breeding and other habits of birds kept in captivity under conditions approaching as nearly as possible those in nature. Courtship and display can be studied under favourable conditions; incubation periods can be readily ascertained as well as the share of the sexes in building, incubation and tending the young. Such observations must of course be checked by watching wild birds, but they are specially valuable in species where the sexes are indistinguishable by plumage. In such cases the sexes could be ascertained for certain by watching a pair in captivity and one of the birds could be marked.

Among other important subjects suitable for investigation by aviculturists I may mention studies connected with mentality, instinct and cognate subjects. The plumages and other characteristics peculiar to nestlings are also very suitable for study in captive birds. The breeding of hybrids, Mendelian variations and other experiments which may throw light on the processes of evolution is an important and skilled branch. The varied effects of light, cold, heat, dryness and humidity as well as diet, provide for investigation an almost unlimited number of subjects of the highest importance. Under this head I may also perhaps refer to Pathological research as a subject of eminent importance to be undertaken by medical aviculturists.

As aviculturists have been mainly responsible for introductions of birds I shall state here my conviction that all introductions of aliens to any area are fraught with the greatest danger to indigenous species. It is perhaps only in comparatively recent years that we have begun to appreciate how delicate is the natural balance and how easily it may be upset by the introduction of aliens, which for some unascertained reasons may flourish exceedingly and at the expense of indigenous species.

Some References

Heinroth, Dr. O. and Frau M., Die Vogel Mitteleuropas.

Morgan, C. Lloyd, Habits and Instinct.
Beebe, C. William, Geographic Variations in Birds with especial reference to Humidity, Zoologia Vol. I., No. 1, 1907.

Protection

It would be impossible to deal with this subject in its general aspects here, and I will content myself by saying that of the three main points of view—the scientific, the economic and the æsthetic, the first two are of the greatest importance while all require special study. Unfortunately many of those who busy themselves over this subject have regard for only one or other of these points of view and have no real knowledge of the others.

Protection under a Society of Naturalists should be based on scientific grounds, and although economical, and to a certain extent aesthetic and sentimental, considerations must be studied and considered, these should be entirely subservient to the main scientific aspects if we are to avoid a course of action which may result in a mere glorified poultry farming. The protection of really rare species which breed and have bred in any area is by far the most important work from the scientific point of view. If a species is in danger of becoming so scarce in any given area that interference of any sort is likely to affect its natural status as a breeding species in that area, then it becomes a necessary scientific act to prevent so far as possible any such interference. In some cases this can be done best no doubt by the provision of sanctuaries or reserves which are known to be suitable to such species. Such reserves if owned and managed entirely by a scientific society could perhaps serve a double purpose. Besides the fostering of the rare breeding birds and subject to this object, advantage could be taken of the control of such areas by conducting within them properly organized experiments and observations of such kinds as were possible to the society concerned and were without risk of disturbance to the rare species. Reserves used in this way could be made of great scientific importance not only on account of their rare breeding birds, but also because of the researches carried out in them. Moreover, such work properly controlled by experienced leaders would be of the greatest possible advantage as a training for beginners.

We have in this county an organisation—the Norfolk Naturalists Trust, which I suggest could be developed to meet the requirements outlined above, should the directors of the Trust look favourably on such a scheme.

Collecting.—Under the head of Protection it may not be out of place to say a word or two about collecting. In my opinion all collecting of natural objects should be done with a view to advancing our knowledge of those objects. Every specimen so collected should be made full use of, and I may say in passing that unless such specimens are properly collected and preserved with essential data they cannot be made properly useful scientifically. It is impossible to regard as an ornithologist the man who collects birds or eggs merely because they are beautiful or because they are rare in a particular area (e.g. the British Islands), or indeed for any reason which has no scientific basis. Such a collector is anathema to our science and should be treated as such. If this were made clear more widely the very important and highly necessary work of discriminate collecting for scientific purposes would be greatly strengthened especially among the younger generation. Some latitude must be given to beginners who cannot of course be expected to collect in every way correctly. But they should be educated to do so rather than educated not to collect at all. It must be remembered that collecting provides an undoubted stimulus in many cases to subsequent serious study, and it seems to me of great importance to the future of ornithology that this stimulus should be maintained, and that no risk should be run of diverting the interests of a potential ornithologist to other fields by stifling a keen desire to collect.

Structure and Classification

Every ornithologist should know something of the anatomy and physiology of birds and it would be an excellent training for a beginner, who had the time and opportunity, to take a course on the subject. An enormous amount of work has been done in recent years in systematic ornithology, but this has been largely confined to the study of the external features of species and subspecies. A still greater work remains for the laboratory and museum worker. Comparative

anatomy, physiology, embryology, palæontology, pterylosis, feather structure, moults and sequences of plumages are among the subjects in which comparatively little work has been done, and it is amongst these that those who desire to specialize in laboratory work should choose. All these subjects are highly technical and are work for specialists and all I can do here is to point out in a general way the direction which should be taken by those who have the desire and ability to embark in work of this character.

Drawing and Photography

I have left these subjects to the end because they can only be regarded as adjuncts and, however valuable as part of an educational or recording system, cannot otherwise be regarded in a review of ornithological work. Let me advise those with ornithological leanings so to regard and use them. To be more explicit I would say that an ornithologist should not be concerned with the taking of a picture as such, but should use his camera, his cinematograph, or his pencil to record definite facts. Unfortunately, it is more usual, though by no means invariable, for those who use a camera to think firstly of the photograph and only secondly of observation, but to become an ornithologist it is necessary to reverse this order.

Conclusion

In conclusion I would say that every exact first hand observation is of value, but this often only becomes apparent when many isolated observations on the same subject have been co-ordinated and worked up to show their significance. For this we want specialists and I would appeal to my audience to take up some definite line and specialize. It should be possible in the future to have acknowledged specialists in all branches of observation, who would collect published and unpublished notes on the particular subject on which they specialize and publish from time to time co-ordinated papers giving the results, showing the progress that had been made, and pointing out the nature of the observations still required.

II

THE FRESH-WATER CRUSTACEA OF NORFOLK

By Robert Gurney, D.Sc.

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In two papers published in these Transactions I have given some account of the Crustacea of the Broads and rivers of East Norfolk ([2, 3]). During 1903 and 1904 about 900 collections were examined, and the total is now probably about 2,000, the result being that the mass of notes has grown to indigestible proportions. I do not propose to inflict on any reader a detailed account of the results, but, since I shall not now be able to carry the work any further, the time seems to have come to offer as general a survey as possible of the Crustacean fauna in the light of present knowledge. I am well aware that much remains to be done. A large part of my work, indeed most of it, has been rather of the nature of a preliminary survey. Problems remain for solution which the exigency of this survey work prevented me from attacking.

I shall deal first with the area of the Broads, an area which, in its physical features and past history, is of quite exceptional interest.

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LEGEND.—Map of East Norfolk showing rivers and valleys. The dotted area is 10 feet or more above Ordnance Datum

The Physical Features of the Broads and their Effect on the Plankton and the Crustacea

The nature of the fresh-water fauna of any area depends largely upon the chemical constituents of the water, and that in turn upon the geological history and present relief of the land. Norfolk as a whole is founded on the chalk, which is at the surface at Norwich, but dips so rapidly to the east that it cannot directly influence the surface waters in the region in question, except in the Yare valley to some small extent. Above the chalk is the Crag, consisting of deposits of sand or gravel often impregnated with iron oxide; but these deposits are not very extensive and are not as a rule at the surface in the immediate neighbourhood of the broads. They no doubt influence the nature of the deeper waters,* but probably only to a very slight extent those of the surface. Overlying all, however, is the great sheet of glacial drift, comprising gravels and clays of varying quality, and these directly determine the qualities of the waters, and to some extent the components of the fauna and flora. According to the views of Mr. F. W. Harmer, this drift is of two sources, namely the North Sea drift, and the Chalky Boulder Clay. The two sheets are supposed to meet and overlap roughly along a line between Norwich and Winterton, dividing the Broadland into north and south halves. There is, however, no very material difference between the two for our purposes. In both cases the glaciers ploughed their way over country where chalk was exposed, and in both cases the drift forms rich arable land. The drainage waters will then be always relatively hard and, owing to the large areas of highly cultivated land, will tend to be exceptionally rich in dissolved salts and organic matter. The water is, therefore, neutral or alkaline. A rather striking indication of its alkalinity is the almost complete absence of erosion of molluscan shells. Old shells of *Anodonta* may be dredged up almost everywhere, and are generally in perfect condition. In the Friesland Meres, on the other hand, an area which has some resemblance to Broadland, erosion is very rapid and even living shells may have the umbones quite perforated. Old dead shell are always greatly eroded.

* See Appendix I. 1.

On the other hand the lime-content of the water is not very great and rarely, if ever, is lime seen to be deposited on the floor of marsh pools. A deposit of this kind, leading to the formation of a bed of marl, is sometimes seen outside the area, as at Flordon Common and Smallburgh Fen. The latter is within the drainage system of the river Ant, and the excess of carbonates is difficult to account for.

Taking, then, first the factor of surface drainage, the Broads will necessarily be designated as eutrophic waters according to modern terminology, offering optimum conditions for phytoplankton.

There is, however, another factor of the utmost importance to be considered, namely their relation to the sea. It is well known that in geologically very recent times the valleys of the Yare and Bure were occupied by inlets of the sea, and that these conditions persisted down to Roman times and even later. Perhaps the most convincing evidence for the existence of these great post-glacial estuaries is the abundance of shells of Cockles and *Scrobicularia* in the mud of the river bed, and presumably also beneath the marsh peat, in the river Ant at St. Benet's and in the Thurne River ([4, 11]). In 1875 a fine Bronze shield was found close to Sutton Broad buried beneath 7 feet of peat and lying on clean white sand ([8]). Close by were charred logs showing that this was a land surface on which a fire had been kindled. It has been suggested that the estuary extended even to this point, and the conditions must certainly have been very different from what they are now. The whole of this flat area has been artificially embanked and drained and, while much of it is below the level of even ordinary high tides, the greater part is below 10 feet above O.D. and pays a graded "Sea Breach" rate for defence against invasion by the sea. It is, in fact, defended from relapse to the old conditions, not by elevation of surface, but by embankment, and maintenance, by the Sea Breach Commission, of the coastal sand dunes. Until the Commission was formed breaches in the sand hills through which the sea flowed were frequent, and disastrous inundations are recorded down to recent times.

The Broads district is a great alluvial flat through which the rivers wind sluggishly with a fall of about two inches per mile. The whole region has undoubtedly sunk in level since the

glacial period and may be sinking now. Peat beds are exposed on the beach, and the sea covers at high tide peat and clay whereon birches and alders once grew. The Broads probably all occupy hollows in the boulder clay, and are concentrated in what one may call the middle region of the rivers, the upper region being that part of them where they run from the uplands, with relatively rapid current and in well-marked valleys. In the lower region they flow through wide flats built up of estuarine silt and noted for the high quality of their pasture. In the middle region, where the river has been embanked and the soil of the adjacent marsh is peat, the level of the marsh has fallen greatly since the embankment, owing to the long-continued drainage and consequent shrinkage of the peat. In such cases the marsh lies much below the level of the river. This is well seen along the river Ant.

These being the conditions, it is not surprising that the nature of the waters should be influenced both directly and indirectly by the sea, and it is certainly true that, throughout the region of the Bure valley, at all events, the water has a salinity rather more than normal. It is characteristic of the well waters of this district that they generally contain so high a proportion of salt that in many cases they would be condemned for drinking purposes if the source of the salt were not known. (See Appendix I., 5.)

Lying nearest to the sea are the Broads of Horsey, Hickling, Heigham Sounds and Martham, all these draining west by the Thurne river. Here the water is always of a definitely high, though variable, salinity, amounting sometimes to 78 grains per gallon. It is found that there is a salt-water table extending inland a few feet below the surface (13), and it is no doubt from this source that these Broads obtain their salt. Even Sutton and Barton Broads seem to be just within the range of its influence, since their water has a higher salinity than that of the upper Bure Broads.

The fauna is also influenced directly by the tide. Salt water usually flows up the river for about 8 miles, but the salinity is raised to a distance of about 12 miles—say to Acle Bridge (5, 6). Frequently—more often in summer than in winter—under the influence of northerly winds, the range of the tide is greatly increased and salt water may be driven up the river as far as

Horning. Conversely, but very rarely, the river may contain fresh water even down to Yarmouth. The effect of these high tides is traceable by analysis to a very great distance. For instance on March 12th, 1906, with a W.N.W. wind, the tide rose at Southtown Bridge to 9-ft. 9-in. (the normal height being about 5 feet), with the result that a great body of salt water was driven up the river and affected the salinity of the Bure to above Horning. Just below Horning the river contained 22 per cent. of sea water (see Appendix I., No. 4). Analysis of water made on March 21st showed that salt water had even penetrated beyond Barton Broad, and was just traceable at Sutton. At Barton the salinity was 33.8. The effects of this tide continued to be felt for some time. Thus, over a month later, the salinity at Horning was still up to 10.37 grs. per gallon, which is at least twice the normal amount (Appendix I., 3).

How very changeable the conditions in the river are is further shown by the example of another tide, the effects of which were recorded in 1911 ([6]).* In this case the effects of the tide disappeared within a few days, at least in the river, and conditions were so far reversed that a fresh-water fauna was found right down to Yarmouth five days later.

The water of high salinity draining out of the Thurne river enters the Bure at Thurne mouth and is carried up the river on the flood tide, affecting the fauna to some extent as far as South Walsham and Ludham Bridge.

There is another factor which no doubt very greatly affects the fauna of the Broads as compared for instance with that of north German lakes—namely the equable climate. Freezing of any of the Broads is comparatively rare, and never of long duration. This certainly affects the life-cycle of many Crustacea, and explains the rarity of sexual forms of some Cladocera and the survival through the winter of species which, under a continental climate, would die out in winter. In the Baltic region the lakes are generally frozen for two or three months, and the break-up of the ice causes great erosion of the shores. Temperatures in summer are also higher than with us.

* See Appendix II. 9.

It is probably to the high summer temperature that the pronounced seasonal change of form which is characteristic the Daphnias of the Baltic region is due. There is practically no seasonal variation in the Norfolk forms, and *D. cucullata* never has anything approaching the grotesque head crests seen in Friesland and Denmark. The shallowness of our waters has also a good deal to do with this absence of seasonal change.

Something must be said of the depth and bottom deposits of the Broads. They are all relatively small, as the following examples show (16) :—

	Acres.
Hickling and Whiteslea	578
Ormesby, Rollesby and Filby	464
Barton	229
Wroxham	92
Sutton	75

All the Broads are shallow, the depth rarely exceeding 10 feet, so that there can be no thermal stratification. In the Broads of the Bure, namely those of low salinity, and in the Ormesby group, circumstances are highly favourable to a rich growth of phytoplankton, and the water in summer is consequently very opaque and green, but there is seldom, if ever, any striking "water-bloom" except in the Ormesby group where it is sometimes very pronounced.

In these Broads there is deep soft mud or ooze of a grey-green colour, often with much sulphuretted hydrogen, but harbouring a rather rich Crustacean fauna. The mud is exceedingly fine and completely decayed, with few traceable plant remains. In the Broads of the Ant and Thurne the water is commonly very clear owing to the scanty plankton and the bottom varies a good deal. They are always very shallow and often have a rich bottom vegetation of *Chara*, *Utricularia* and *Nitella*. The mud is deep, dark in colour and contains undecayed plant remains. The bottom fauna is scanty. Mud of the Bure type is found in parts of Barton Broad and this mud is calcareous, but neither here, nor anywhere in the Broads, is there any deposit of lime forming a marl or "gytje." In some of the Danish lakes this "gytje" is "so rich in lime that the bottom layer may be directly used as marl to improve the arable soil." (17).

The Plankton

The phytoplankton of the Broads has not been by any means sufficiently studied. The general features are summarised by G. S. West ([18]), and Griffiths ([1]) has published a paper on the subject based on a short visit in August, 1924. While the list of species given by Griffiths for the Broads visited is helpful, he evidently had no general acquaintance with the district and did not appreciate the peculiar conditions. I have not seriously studied the phytoplankton myself, and can only deal with it superficially.

The district cannot be treated as a homogeneous whole for the reasons given above, but may be divided into several sub-regions :—

1. Bure Valley (*a*) Wroxham.
   (*b*) South Walsham.
2. Ant Valley.
3. Thurne Valley.
4. Ormesby Group.
5. Yare Valley.

The Broads of the Thurne, Ant and Yare valleys have peculiar features, and can be dealt with first.

2. In the Ant Valley are Barton and Sutton Broads, the latter so much grown up with reeds, etc., that there is little open water and practically no plankton. At times there may be immense numbers of small Peridinians, giving the water a golden yellow colour, and *Bosmina longirostris* may be present in some numbers. Barton also seems rarely to have any indigenous plankton except a few *Bosmina* and *Diaptomus*, but in the summer it may apparently be invaded by some of the species from the Bure, including *Daphnia cucullata*. Probably the absence of normal plankton is due to some extent to the trace of salt alluded to above.

3. The Broads of the Thurne river, Horsey, Hickling and Martham, have a high salinity and, as West says, the phytoplankton consists only of some species of Peridinians and a few Diatoms of brackish affinities. The plankton is variable, but the most constant member of it is *Eurytemora velox*. There are no Daphnias and rarely any *Bosmina*.

All these Broads are shallow, and those of the Thurne are characterised by immense beds of *Chara* and of *Potamogeton pectinatum*. Twenty years ago *Neomysis vulgaris* abounded, but it has now completely disappeared. *Gammarus duebeni* and *Cordylophora* are still common and owe their presence to the high salinity.

5. With the Yare valley I have little acquaintance. This river has been excessively polluted, and also is more exposed to tidal influence than the Bure. At the times of my own recent visits there has been no zooplankton whatever, the water appearing absolutely lifeless. Griffiths found in Surlingham Broad a scanty plankton "consisting largely of vegetable detritus and epiphytic organisms from the submerged macrophyta." This scarcity is probably a phenomenon of quite recent origin, due to pollution by the Cantley Beet Sugar Factory and partly to the Thorpe sewage farm, since in 1903 there was a very definite zooplankton including *Bosmina*, *Ceriodaphnia* and *Daphnia longispina*.

1 and 4. Bure Valley and Ormesby group. The summer plankton of these two areas and of the river from Wroxham down to Thurne mouth is exceedingly rich and, to a large extent, uniform. It is characterised by the great abundance of the Diatom *Melosira*, which may at times dominate almost to the exclusion of other forms. On the other hand there are features distinguishing the plankton of Wroxham and Salhouse from that of Ranworth and South Walsham, and of these Bure Broads jointly from that of the Ormesby group.

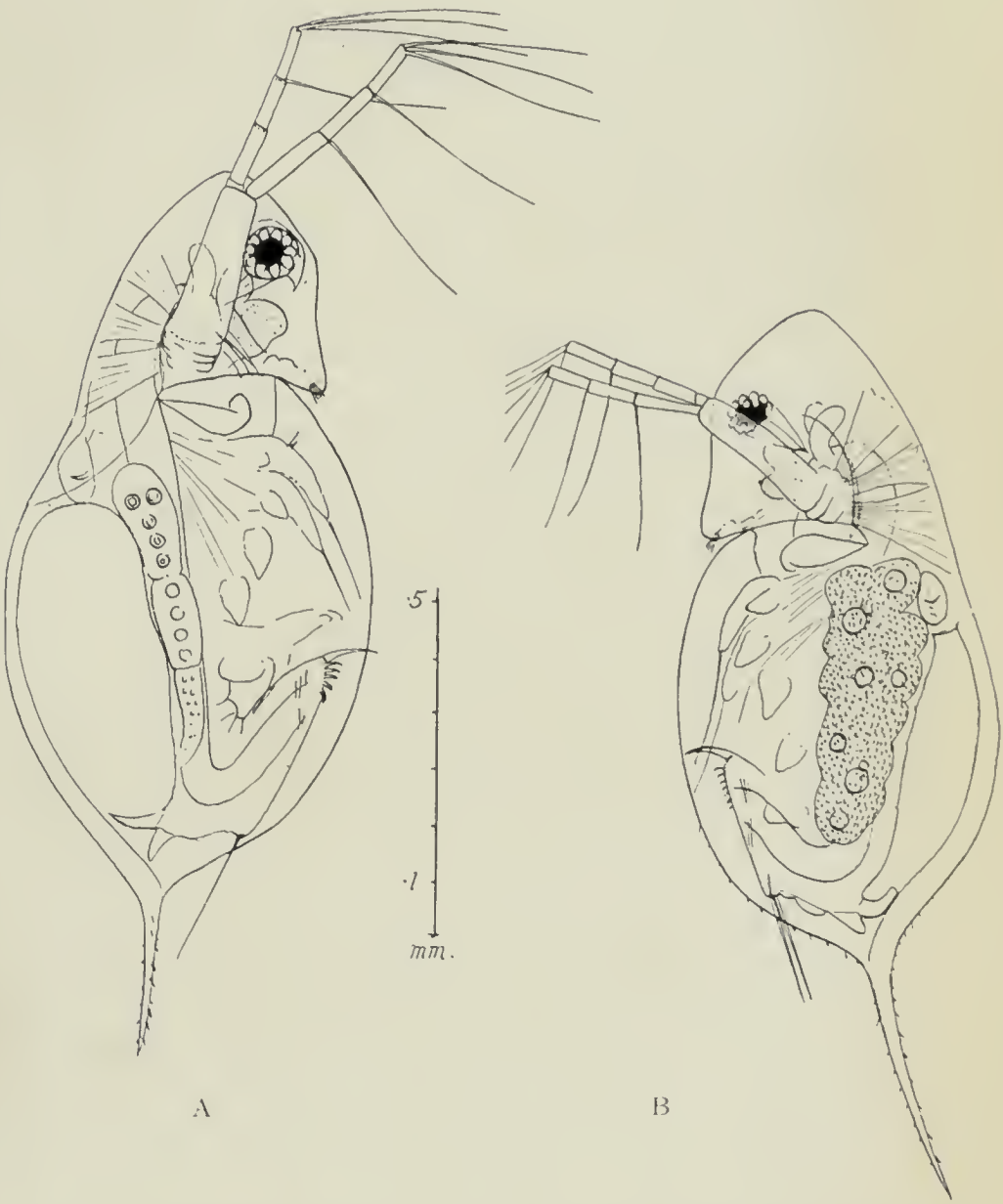
The Bure Broads are characterised by the total absence of *Ceratium* and the presence of *Daphnia cucullata*, but Wroxham and Salhouse are remarkable for the absence of *Diaptomus gracilis* which is the common species of the plankton of the district as a whole. In these two Broads *Eurytemora velox* takes its place, but it is not a case of the exclusion of one species by another since both species occur together in other places. There must be some obscure factor influencing the distribution of *D. gracilis*, the nature of which it is impossible even to guess at.

Ormesby has the richest plankton of the whole region. There is so great a development of phytoplankton in summer

that there is a striking "water bloom" which lasts from about the end of April to the end of June. At such times the water seems to be covered with a coat of emerald green paint. This seems to be mainly due to Myxophyceæ—*Anabæna*—but there is an enormous quantity of *Melosira* and a large variety of Protococcales. Naturally the components of the plankton vary with the season, and *Microcystis æruginosa* may contribute to the bloom. *Pediastrum* and *Asterionella* are common, and *Ceratium hirundinella* is present in small numbers and at some seasons. (See Appendix II. 8).

Eurytemora velox appears to be absent, while *Diaptomus gracilis* is abundant throughout the year. Daphnia abounds, but it is difficult to determine to which species it should be referred.

In my list of Crustacea published in 1904 I included both *Daphnia lacustris* and *D. cucullata*, relying chiefly upon the presence or absence of the ocellus as a distinguishing character, since at that time this was regarded as an important and easily recognised difference. In the meantime the literature poured out upon the subject of the *D. longispina-cucullata* group has been prodigious. The result is that all the barriers between species and varieties have been broken down, but we have no sure guide to their understanding. In the Norfolk Broads the pelagic form of Daphnia is a small form with almost no seasonal variation. The young frequently, and the adults rarely, have peaked heads in summer, but there is never a conspicuous crest. Taking a single plankton sample in summer it is quite impossible to separate two races or species by external form. On the other hand the ocellus may be fully developed, or it may be represented by a minute pigment spot embedded in the brain, or it may be quite invisible. The dorsal processes of the abdomen may be of the form characteristic of typical *D. cucullata* or of *D. longispina*, or intermediate between the two. What name, then, can we give to this Daphnia? It is, I believe, the same form as that recorded in 1892 by Scourfield from Essex as *D. galeata*, but it is certainly not the same as the large *galeata* form so common in the Scottish plankton, and it is, I think, misleading to give it that name.



Daphnia cucullata.—A. River Bure at South Walsham, Aug. 1st, 1909: B. Ormesby Broad, May 31st, 1911. Two individuals obviously of the same species, but one (B) with ocellus, and the other (A) without.

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I consider it best, provisionally, to regard the pelagic Daphnia of Norfolk as *D. cucullata* of the var. *apicata*.

The common *longispina*-form of the Broads is *longispina-rosea*, but a great variety of forms has been met with at different times, from which an almost unbroken series might be built up between it and the *cucullata*-form here dealt with. I give figures to show the pelagic form with and without ocellus.

Comparison with other Areas

It is difficult to compare the Broads as a whole with any other lake area. They have nothing in common with the lakes of Cumberland or Scotland, where the Crustacea are totally different.* Neither do they seem to have any close resemblance to the lakes of Friesland, where *Bosmina longirostris* is accompanied or replaced by *B. coregoni* and *Dinobryon* is abundant in the plankton. It is true that there is a greater similarity with the Naardermeer in Holland, and I have seen similar plankton from near Gröningen; but here one finds Leptodora, which does not occur in Norfolk.

Griffiths ([1]) considers that the closest parallel (having regard to the Phytoplankton) is with the Danish lakes. There are, however, marked differences in the Zooplankton. The Baltic area is conspicuously the home of *Bosmina coregoni*, *Leptodora* is of general occurrence, and *Diaphanosoma* is a regular member of the plankton.

Taking the plankton of Ormesby as typical of the Broads, it is thus characterised :—

(1) Dominance of *Melosira* and abundance of *Cyanophyceæ*.

(2) Absence of *Ceratium*. It is occasionally present in Ormesby, but very rare. Entirely absent from other Broads.

(3) Absence of *Cyclops oithonoides*, *Leptodora*, *Bosmina coregoni* and usually of *Diaphanosoma*. The latter is common in ditches or weedy waters, but rare in plankton.

(4) Presence of *Daphnia cucullata*, *Bosmina longirostris*, *Cyclops vicinus*. *Eurytemora velox* present in other Broads.

I do not propose to go deeply into this question; but I think one may say that the plankton of the Norfolk Broads

* See Appendix II. 10.

belongs generically to the Baltic type, but that it has marked specific differences attributable partly to marine influence and partly to the factors of depth, size and climate.

Littoral and Bottom-Living Crustacea

Turning now to the littoral and bottom-living Crustacea we find the interest of the region equally great.

The shallow weed-grown Broads are extraordinarily rich in Entomostraca, but the richness depends to a large extent on the nature of the vegetation and the salinity of the water. Beds of Chara in Hickling for instance harbour relatively few species, but a great abundance of individuals of species such as *Simocephalus vetulus* and *Eurycercus lamellatus*. This is also the case in other Broads and is due to some peculiarity in the *Chara* rather than to the high salinity.* The high salinity of Hickling does, however, account for the presence of *Nitocra lacustris* and *Mesochra rapiens*. *Horsiella brevicornis* is another Copepod which prefers a rather high salinity and is commoner in Hickling and Horsey than elsewhere. It is a remarkable species closely allied to the marine *Cylindropsyllus*, found only in decaying stems of *Typha* and *Scirpus*, and seems to be widely distributed though rarely seen. It is recorded from Greifswald, Dalmatia and West Siberia, and I have found it myself at Ismailia in Egypt.

The richest life is found in Sutton Broad, among the thick mass of *Potamogeton* and *Nymphæa*. Weeds such as *Hippuris*, *Myriophyllum* and *Ceratophyllum*† do not seem to be very favourite habitats. Beds of *Sparganium minimum* sometimes provide a home for incredible numbers of Entomostraca, particularly *Sida*. (See Appendix II. 4). In the Broads of the Bure, and in the Ormesby group, there is only a narrow belt of vegetation and nothing approaching the wealth of weeds seen at Sutton or Barton. Consequently the Entomostraca are much fewer in number and variety. On the other hand they have a relatively rich bottom fauna, including all the three known British species of *Ilyocryptus*. *I. sordidus*

*Investigation of the pH of the Broads may throw light on this and other difficult points.

† These two plants are dominant in the Yare Broads and perhaps explain to some extent the poorness of the fauna.

seems rather indifferent to the nature of the bottom and is often common in quite coarse deposits, but *I. acutifrons* and *I. agilis* are rarely seen except in fine flocculent grey mud.

In general the Crustacean fauna is characterised by its great variety and the absence of all northern forms. In the Cumberland lakes, for instance, the characteristic littoral Cladoceran is *Alonopsis elongata* and this is commonly accompanied by *Drepanothrix dentata*, but neither of these occur in the Broads. There are none of the northern Harpacticids, but we have *Nitocra hibernica* and *Canthocamptus trispinosus* which are not found in the north, and *Cyclops leuckarti* and *C. hyalinus* are common in our summer plankton but are never seen in the plankton of the lakes of Cumberland or Scotland.

Of the river Crustacea the most interesting is *Leander longirostris*, the "White Prawn" or "Jack Shrimp" of Breydon. Previously wrongly named as *L. squilla*, this was recorded for the first time as a British species in 1921 ([9, 10]). It is now known to occur also in the Tamar in Devonshire. Curiously enough I identified its larva in plankton from the Eddystone Grounds years before it was known to live in any other rivers than the Bure and Yare. This prawn is almost as much at home in fresh as in salt water, and certainly runs up the river as far as Hickling and South Walsham, and may penetrate normally to fresh-water. Its range of tolerance is much greater than that of *Palæmonetes varians* which is very sensitive to water of low salinity. The Jack Shrimp, however, goes to sea to hatch its young, and indeed its eggs will not hatch in fresh water, while the larvæ of *Palæmonetes* thrive in brackish water.

I have not much to add to previous lists of littoral forms. A number of species have been added from the estuarine region, but they are not of general interest. The region between Acle and Stokesby is, roughly, the limit of distribution of the brackish species*. Only one ranges much beyond this, namely *Tachidius littoralis*, which is established in fresh-water in South Walsham Broad.

It is rather remarkable that *Carcinus mænas* (the "Kittiwitch" of Norfolk) and the Brown Shrimp (*Crangon vulgaris*), though they swarm in Breydon and are typical estuarine

*For an example of the fauna of this section of the river see Appendix II. 3.

species, are absolutely confined to salt water. I have never found any evidence of their ranging beyond the reach of salt tides. The Flounder, on the other hand, runs up quite into fresh water and I have caught a specimen in the middle of Wroxham Broad. It is taken commonly, in company with the White Prawn, in the eel-sett at St. Benet's.

The Fauna of Brackish Waters

In discussing the fauna of brackish water one meets at once with the difficulty of defining the term numerically, and any study of the question leads to the conclusion that we are dealing with a problem which is not solely one of the chemical composition of water. Redeke ([14]) has divided brackish waters as follows :—

Oligohalin with .1 to 1.0 grm Chlorine per litre.
Mesohalin with 1.0 to 10.
Polyhalin with 10 and more.

It is no doubt possible to make a rough separation of habitats in this way, but I feel that it is premature to divide and label associations on the basis of a single factor. Undoubtedly salinity is the only indicator of which we have reasonably precise knowledge, but it is certainly not the only determining factor, and it is just to this point that limnologists might with advantage direct their attention.

The brackish-water fauna is merely one branch of the fauna of a region ranging from open sea to pure fresh water, and it is impossible to draw hard and fast lines. In the first place the conditions of life for the plankton and the bottom fauna do not appear to be the same. The Copepod plankton of the open sea is not the same as that of littoral waters. These waters are characterised by the predominance of certain species which are less frequent in the open sea—e.g., *Acartia clausi, Centropages hamatus, Temora longicornis* and *Euterpina acutifrons ;* but there is no accompanying notable difference in salinity. The difference is perhaps attributable more to the predominance in coastal waters of certain forms of phytoplankton, themselves dependent upon the influx of nutrient salts from coastal drainage.

Passing from the open coastal waters to the more confined estuarine region we still find the same, or nearly the same,

plankton, but with the addition of such species as *Acartia bifilosa* and *Eurytemora affinis*. The water is still definitely sea water, but may be liable to fluctuations of salinity, and the determining factors may be as much depth, turbidity and currents as salinity. Between the outer estuary and the region of fresh water there is an ill-defined area of fluctuating extent, liable to violent changes in salinity and hardness, strong currents and changes in temperature conditions, in which no new and characteristic plankton forms appear, but the species of the outer estuary disappear and only *E. affinis* survives.

E. affinis is certainly a euryhaline species, but how far the same can be said of the other estuarine plankton forms is uncertain. They may be carried up and down with the tide, remaining always in water of approximately the same composition, and the occasional presence of specimens in water of low salinity may indicate no more than the capture of stragglers surviving for a time in an uncongenial, and ultimately lethal, element. As an example I may refer to Oberg's remarks on *Paracalanus parvus*. This species is common in the Bay of Kiel and in parts of the Baltic, but he found no evidence of its actually breeding there, and concluded that it was being constantly brought in by currents from the North Sea. Conversely he stated that *Eurytemora hirundo* is carried out into the Baltic from brackish water, but unable to establish itself there.

Speaking from an experience limited to the conditions in Norfolk, I should say that the brackish-water (euryhaline) Copepod plankton consists only of *E. affinis*—with its varietal forms.

Such a conclusion would hardly be admitted as applicable to the Baltic, but the conditions there are so different from those on our own coasts that no exact comparison is possible. In a relatively tideless sea, of which the highest salinity is far below that of the North Sea, and the salinity gradient is very gradual, the mixture of marine and fresh-water forms is very much more intimate than it is elsewhere.

Turning to the littoral and bottom fauna, we go from conditions of comparative simplicity and uniformity to conditions of extreme complexity, and it is impossible at present to unravel the factors operating. We cannot speak of a " brackish-

water fauna" as a simple community, as we can with the plankton; for, while it is possible to draw up a long list of species commonly or exclusively found in brackish water, there are several obviously different types of habitat, each of which has its characteristic species. For instance, on many parts of our coast, as at Blakeney and Wells, there are stretches of salt marsh covered with maritime plants, chiefly *Obione*, and dotted about with small shallow pools of peculiar form. These pools have a level bottom of fine sticky mud and no vegetation apart from the overhanging plants of their edges, and they vary in depth from a mere film of water to about a foot. Their fauna has not been fully studied, but it is rich in Ostracods and Copepods, and it is in these pools that *Palæmonetes varians* particularly thrives. Of the Copepods *Tachidius brevicornis*, *Mesochra lilljeborgii* and *Metis ignea* are characteristic, but a long list might be made from an extended study of them. The salinity is probably on an average very near that of sea water, but it fluctuates much according to the amount of rain and also owing to the fact that the marshes are periodically overflowed by the sea. After such a flood the pools may be found to contain marine plankton, and these forms (e.g. *Acartia clausi*) may survive for a considerable time. There are, towards the edge of the marsh, pools which are not, or only very rarely, flooded. These have a salinity which is very high, and contain not only *Palæmonetes* and *Tachidius*, but also immense numbers of *Eurytemora velox*—a species which is equally at home in quite fresh water.

Again, on the Norfolk coast, there are at Salthouse some large ponds lying on the landward side of the shingle bank. These ponds have, for the most part, a stony bottom, and their water is of high salinity, though generally a good deal less than that of the sea (e.g. 1456 parts Cl per 100,000). Here there is a rich vegetation of *Ruppia rostellata*, and the fauna is quite different from that of the marsh pools. Conspicuous species are *P. varians*, *Idotea viridis*, *Gammarus locusta* and *Neomysis vulgaris*. On the stones are numbers of the interesting Anemone *Sagartia luciæ* and much *Membranipora monostachys*. In places the Hydroid *Gonothyrea loveni* is found. The Copepods are not numerous and are generally not of the same species as in the marsh pools. The commoner

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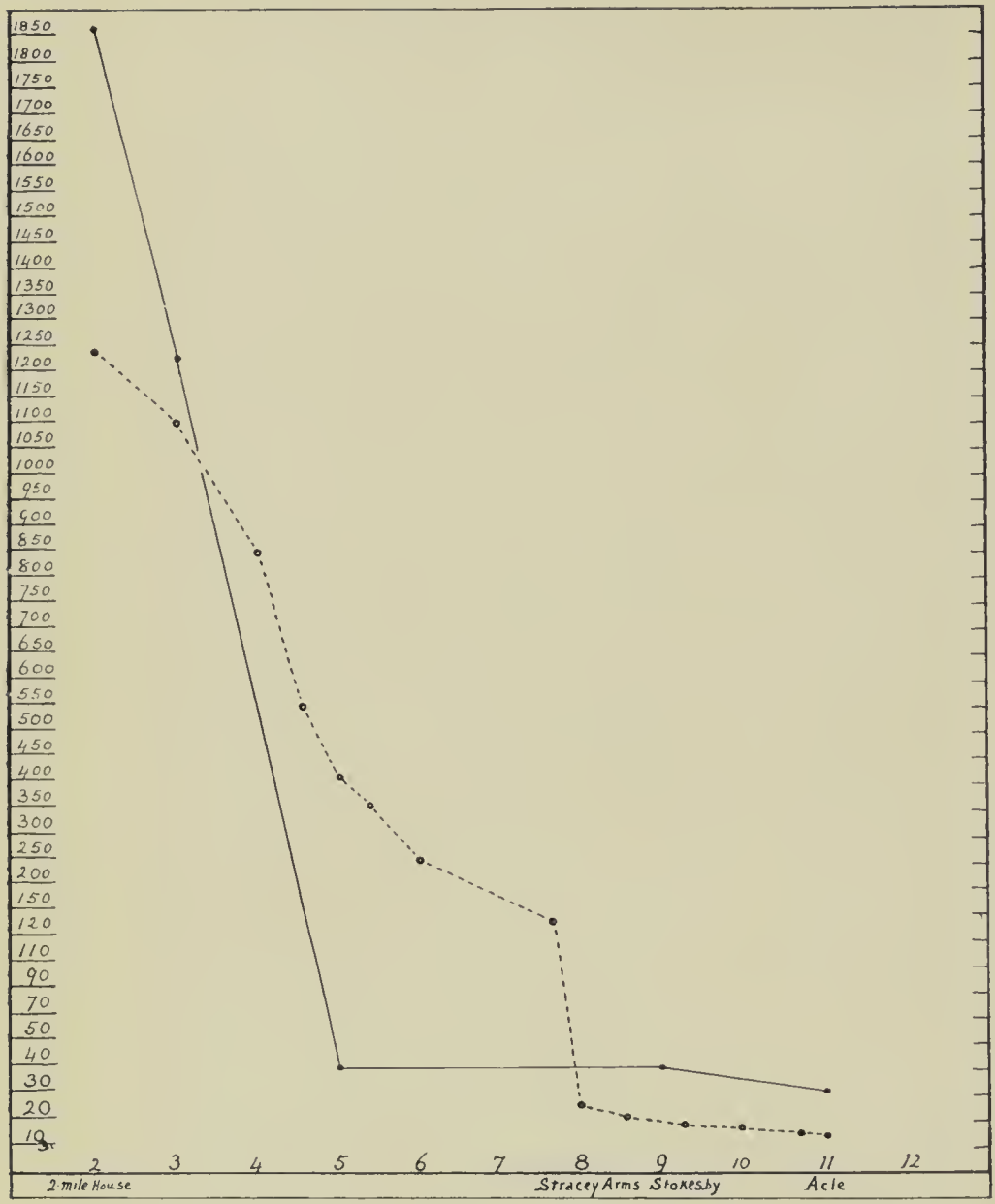

FIG. 1

SALINITY GRADIENTS IN THE RIVER BURE

Salinity expressed as grains of Chlorine per gallon. In order to bring the great range of salinity within the diagram the value of the vertical intervals is made to increase upwards. The horizontal intervals represent miles from Yarmouth.

Solid line - —— April 9, 1906. W. L. Sutton. 9 a.m.—10.30 a.m.

Broken line - - - - Oct. 2. 1906. A. G. Innes. 9 a.m.—12.50 p.m.

In both cases high water at Southtown Bridge at 9.30 a.m. and the moon was full.

forms are *Halicyclops magniceps* and *Nitocra spinipes*. Curiously enough I have not found any *Eurytemora* in these ponds.

Here, then, we have two kinds of pool of which the only common factor is the high salinity, but the fauna is as different as possible, and it is clear that there are several categories within the "brackish-water fauna."

In the river Bure between Yarmouth and Acle a considerable number of brackish species have been taken at different times. The commonest species of Copepod of the bottom is *Tachidius littoralis*, which is some places is to be taken in enormous numbers. In fact it is the dominant species and there is no other that is really common. It is evidently specially adapted to the exacting life of a river, most other species requiring the relatively tranquil conditions of ditches and pools. Of the higher Crustacea *Heterotanais gurneyi* proves to be very common, and *Cyathura carinata* and *Corophium grossipes* are probably so but are not so easy to find, as they burrow in the mud.

Carcinus maenas and *Crangon vulgaris* do not extend far up the river at ordinary times, being confined to practically salt water, but *Leander longirostris*, as has been said, is indifferent to the amount of salt. *Balanus improvisus*, which is abundant in Oulton Broad, has been taken as far up the river as Muckfleet, but it is not well established in the river itself. This is no doubt due to the uncertainty of the conditions for larval life.

Two species of this region, *T. littoralis* and *L. longirostris*, are completely euryhaline, but it is difficult to be sure of the others. It must be remembered that one cannot ascertain precisely the conditions under which they are living. Thus, although the river may at any point appear to be full of fresh water, it is very possible that there are, as it were, pockets of salt water in holes and crannies of the bank left over from a preceding tide, and that the "brackish" species are really living in water of high salinity (see Appendix II., No. 3).

We can, however, again draw the conclusion that salinity is not necessarily the determining factor, and that the conditions in a river definitely exclude a number of species which, in pools, can tolerate a high and fluctuating salinity.

Breydon Water

Breydon Water offers conditions intermediate between river and pool, but has not been studied with the attention it deserves. The fluctuations of salinity are here, too, violent, but the water is usually nearly normal sea water. Apart from the main river channel there are great stretches of mud laid bare at low tide and there are also shallows thickly overgrown with *Zostera*. In these *Zostera* beds the fauna is very rich, and consists of typical "brackish-water" species. *Halicyclops magniceps* may be the dominant Copepod, but the immense numbers of the small mollusc *Paludestrina* simply clog the net. As an instance of the curious mixture of species that may be met with sometimes in Breydon, I give a list in the Appendix II. 7 of a collection made at the north end during a time when much fresh water was flowing down. There can be little doubt that on this occasion, though salinity was lowered throughout, salter water was retained over much of the bottom and among the weeds. The brackish species, then, though able perhaps to endure for some time a lowered salinity, are not necessarily adapted to live in it permanently.

I think it of importance to emphasise the necessity for caution in attributing to bottom-living forms the power of adaptation to the salinity of the water in which they are apparently found. Buxton (1924) has shown the great difficulty in ascertaining the temperature conditions under which desert insects live, and we have here a problem almost more difficult.

One point which seems worth noting is that it is not the species of the rock pools and tidal zone such as *Tigriopus fulvus*, *Tisbe furcata* and *Carcinus mænas* which tolerate best the lower density of the upper estuarine region, and it is not *Palæmonetes varians*, though reputed the most characteristic species of brackish water, that ranges into fresh water, but *Leander longirostris*, which none the less finds it necessary to go down to the sea to breed. We are, indeed, dealing with a region where there are cross currents of adaptation of which we have no understanding. I venture to think that it is a region more worthy of the attention of the modern student of aquatic life than the region of pure fresh water, concerning which so much has been written already, that progress of under-

standing seems likely to be impeded by the weight of accumulated fact.

Under the head of " brackish-water " fauna is also sometimes included the fauna of inland waters, the high salinity of which is due to drainage from saline deposits or evaporation of lakes without outlet. Inasmuch, however, as the salinity is generally higher and not less high than that of the sea, they do not fairly come within the same category.

The term " brackish-water " should be applied only to waters which, permanently or temporarily connected with the sea, have a salinity or density less than that of sea water. Brackish water is, in fact, diluted sea-water.

The water of inland salt lakes and pools has generally a composition different from that of sea water in the relative proportions of the salts. The salt pans into which sea water is admitted for the purpose of ultimate evaporation for the recovery of salt may pass through at certain seasons a brackish-water phase, as in the salines of Croisic, and contain for a time a mixed or euryhaline fauna ; but, when evaporation sets in they pass into the salt-pan phase, while the fauna changes with changing density till ultimately only *Artemia* is able to survive.

In cases such as this we have the factors of density and acidity changing while the rest remains the same. Labbé ([12]) has devoted much attention to these salines and has published much valuable information about them ; but his work is throughout directed to establishing a wholly untenable theory of the transformation of species from one to another by the influence of small changes in hydrogen-ion concentration. The new species and " allomorphs " described are so fantastic that it is unfortunately impossible to discover in his papers any really reliable information concerning the reaction of any definite form. It is certain that he was dealing wholly or in large part with species already known, but they are so disguised that they can seldom be recognized with certainty.

The interest of a study of the brackish-water fauna lies in the light it may throw upon the origin of the fauna of fresh water.

The statement is often found in literature that in *Cordylophora lacustris* and *Dreissensia polymorpha* we see two species actually in process of migration from the sea to fresh water. This seems to me a false view. *Dreissensia* is a very definitely fresh-

water species, quite intolerant of salt water, and there is no shadow of evidence that it has changed its habits in historic times. *Cordylophora* is by no means an estuarine or even brackish-water form. It is able to live in perfectly fresh water, but prefers a salinity of about 20 to 50 parts Cl. per 100,000, and is able to tolerate higher densities for a time. It is not markedly euryhaline, and its distribution does not show evidence of recent penetration from the sea. The discovery that it is identical with *C. caspia* Pallas has thrown new light on its origin, which is probably connected with the past extensions of the Baltic and Caspian Seas.

The fauna of estuaries seems to consist of species which are in a sense euryhaline, but within relatively narrow limits, and in very few cases is there evidence of extension of these limits. The best case is that of *Paludestrina jenkinsi* (see Robson [15]) which seems definitely to have passed from brackish to fresh water within quite recent times. It is known to have inhabited Britain since about 1550, but was not actually described until 1889. Up to about 1893 records show it to have been a relatively rare species inhabiting brackish water. From that date it seems suddenly to have multiplied to an enormous extent, and to have pushed its way, far and wide, into fresh water.

It seems probable that the colonisation of fresh water has occurred, not by the gradual acclimatisation of estuarine species, but by the occasional appearance of physiological mutations giving a new range of tolerance of low salinity. Such mutations need not necessarily be accompanied by structural change. *P. jenkinsi* of to-day is apparently identical with the *P. jenkinsi* of mediæval times, but the *P. jenkinsi* of fresh water is certainly physiologically a new species.

Additional records for the County, outside the Broads District

Exploration beyond the Broads district has brought to light some interesting waters. Generally speaking, ponds and ditches in the area covered by the boulder clay are likely to contain no species not already recorded for the Broads or adjacent waters, but wherever there is a marked difference in physical features a new fauna is to be expected.

Heaths and Spring Waters

Thus there are heaths where the water supply is "acid" and the vegetation is of the "bog" type. Examples are Newton Common, Buxton Heath, parts of Booton Common and Roydon Fen (near Lynn). The indicator plant is of course *Sphagnum*, with which *Drosera** is generally associated. Both *Sphagnum* and *Drosera* may be found in the Broads district, but only in small areas and then without any characteristic fauna. In other places, however, one finds a definite "sphagnophil" fauna, the Crustacea being *Moraria brevipes*, *Canthocamptus weberi*, *C. echinatus*, *C. zschokkei*, *Alona rustica* and *Chydorus piger*. *M. brevipes* proves to be widely distributed and sometimes abundant. *C. weberi* was first found on Newton Common in 1921. It is, however, by no means a very rare species, since it inhabits moist *Sphagnum* and can be got by squeezing the water from the moss into a fine net. In this way I have also found *Epactophanes muscicola* at Buxton Heath, a species not previously known in Britain.

One of the most interesting discoveries is the occurrence of *Canthocamptus cuspidatus* in a spring at Holt Lowes. Here it is associated with the Planarian *Polycelis cornuta*. Both are northern "cold-water" species sometimes alluded to as glacial relicts. This they certainly are not here. They owe their presence to the relative coldness of the water, but how they can have got there I cannot suggest. We know too little of the means of distribution of these Crustacea to draw far-reaching conclusions from their occurrence in isolated colonies. The Ostracod genus *Limnicythere* is sometimes claimed as a glacial-marine relict; but *L. relicta* was found in a small pond just below the springs on Holt Lowes which was made by embankment during the war.

The Meres

The Meres of West Norfolk, near Thetford, are of much interest by reason of their rather problematical origin and their situation amid the barren Breckland ([16]). They all occupy depressions in the chalk, and the level of the water depends

* *D. rotundifolia*. This is replaced by the long-leaved species where the water is charged with lime, e.g., at Smallburgh.

mainly upon the level of saturation of the latter. Consequently this level fluctuates, and a mere may dry up entirely after a succession of dry seasons. The water is, of course, "hard." A characteristic of some and perhaps of all the meres is the enormous numbers of mollusca that inhabit them. I have not seen any *Anodonta**, but the number of dead shells of *Limnæa stagnalis* round the margin of a shrinking mere is most striking. I have collected Crustacea in several of the meres and the pools in their neighbourhood, but will refer only to Langmere and a pool at Larling. During the years 1917-19 Langmere was very full, and had apparently been so since 1912. At this time there was a rich fauna, and it included great numbers of the remarkable and rare Rotifer *Pedalion mirum*. It is notable that *Ceratium*, *Volvox* and the Polyzoan *Lophopus crystallinus* were all abundant. About fourteen species of Cladocera and Copepods were found, and the characteristic Cladoceran was *Daphnia longispina*—on the whole a fauna of clear, permanent and open water. In 1921 there was a season of exceptional drought and the mere was reduced to three separate ponds. In these ponds the fauna had changed entirely. Instead of *D. longispina* there was *D. magna*, a species characteristic of farm ponds, and only five species of Entomostraca in all were present. *Ceratium*, *Lophopus* and *Pedalion* had gone.

Normal conditions have gradually been restored, but not the original fauna—at least it was not so in 1926 and 1927. This is a fact of some general interest. Many fresh-water animals have resting eggs, or can survive drought in some other form, and from a sample of the dry débris taken from the edge of Langmere in 1920 and placed in an aquarium the following species were hatched—

Lophopus crystallinus
Daphnia longispina
Ceriodaphnia reticulata
Alona rectangula
Canthocamptus staphylinus
Cyclops rubellus

* I refer only to the meres on Wretham Heath. Scoulton Mere, for example, is quite a different kind of water, and has abundance of *Anodonta*.

One would expect then that, as the mere extended, the drift line would be submerged and the old fauna restored. Apparently this has not happened, and one may conclude that the life conditions are now in some way different and unsuitable, even though the original dimensions and depth may have been regained. The introduction of new species, such as *D. magna* may easily be accounted for by transport by birds, since the mere is frequented by numbers of ducks. At the same time we have very little positive evidence of the means by which fresh-water animals are distributed and this is a subject of great importance from the point of view of zoo-geography. The evidence given above of the failure of a lake to repopulate itself in spite of the demonstrable presence of the resting eggs of some of the species makes the ready colonisation of new waters even more difficult to understand.

Mention should be made of a small pool on Larling Heath which was first examined in May, 1927. The pool has a rich vegetation and a very rich fauna, but there is nothing definite to distinguish it from other pools in the vicinity. Yet it was found to contain two species quite new to Britain—*Cyclops gracilis* and *Echinisca tenuicornis* (*Macrothrix rosea* auct.) Only one specimen of the latter was seen and repeated search on subsequent visits failed to produce any more. *Cyclops gracilis* has since been found in one other pool near by. A list of the Entomostraca of the original pool is given in the appendix.

East Ruston Common

The richest hunting ground for Entomostraca which I have found has been East Ruston Common. Here, alongside the road, is a wet marsh with a mossy bottom in which *Utricularia* (three species) abounds. Here, in an area of only a few square yards, I have taken twenty-five species of Cladocera and twenty-four of Copepods as well as several specially interesting Ostracods (see Appendix II. 1). Among these were some of extreme rarity :—

Ceriodaphnia setosa new to Britain
Kurzia latissima new to Britain
Cyclops rubellus
Canthocamptus gracilis

Metacypris cordats
Candona euplectella

Canthocamptus gracilis is a species which turns up fairly often, but generally only as single specimens. At East Ruston it was found to be quite common in the bladders on the earth-shoots of *Utricularia intermedia*. This fact gave a clue to its real habitat, and I found it could always be taken deep down in the moss.

Such flooded marshes, with submerged moss, are always very rich in Entomostraca, but I have met with none so rich as this.

Westwick Perch Pond

For the sake of completeness I may mention this pond although it has already been fully dealt with in these Transactions (7). It is a large pond, artificially formed in 1819 by the embankment of a small valley in the glacial sand. The bottom slopes down to a depth of about 14 feet and is, for the most part, covered thickly with Littorella, a plant which is of very rare occurrence in the Broads district. In fact I have only once seen it myself in a gravelly bay at Sutton. The water is exceedingly clear and phytoplankton very scanty. The pond approaches in several respects to the character of a small highland lake, and is totally unlike any other pond in Norfolk with which I am acquainted. The fauna is not rich, but it contains some species of Cladocera characteristic of "acid" waters, two of which are not known from any other locality in the country. These species are :—

Acantholeberis curvirostris
Drepanothrix dentata
Leptorhynchus falcatus
Chydorus piger
Alona rustica.

The only conclusion one can draw from the occurrence of these species in this pond, little more than 100 years old, is that the Cladocera have unlimited powers of dispersal and are able to colonise all suitable waters in a very short time. They are not suitable material from which to draw conclusions regarding glacial history and the like.

Subterranean Crustacea

In 1899 Sir Sidney Harmer* recorded the finding of the subterranean Amphipod *Niphargus aquilex* in a well at Cringleford; but, so far as I know, the animal has not been seen since in Norfolk. Last year Mr. John Gurney sent me two specimens of a species of Niphargus taken from a pump at Walsingham. These were submitted to Prof. Tattersall, but he was unable to identify them with certainty as they were not mature. Apparently they belonged to the same species as the specimens from Cringleford, and this is now generally called *N. puteanus* (Koch). As these subterranean Crustacea are of exceptional interest I should like to appeal to members to look out for them. They are likely to be met with in wells sunk in the chalk, and could be got by tying a bag of fine muslin over the mouth of the pump.

Additional Records of Crustacea

Cladocera

Moina macrocopa, Straus. Pond at Titchwell. (D. J. Scourfield, August, 1912).

Macrothrix hirsuticornis Norm. and Brady. Dersingham, April, 1919. Drymere, Swaffham, hatched from mud, October, 1920.

Echinisca tenuicornis (Kurz). Larling Heath, May, 1927. (Syn. *Macrothrix rosea* auct. non Jurine).

Acantholeberis curvirostris (O.F.M.) Westwick Perch Pond. Newton Common.

Drepanothrix dentata (Euren). Westwick Perch Pond.

Alonopsis ambigua Lillj. Pond at Herringfleet. Hickling Broad, July, 1919.

Alona protzi Hartwig. Ludham Bridge, September, 1920.

Ceriodaphnia setosa Matile. East Ruston Common.

Kurzia latissima (Kurz). East Ruston Common.

Chydorus piger Sars (Syn. *C. barbatus* Brady) Westwick, Buxton Heath, East Ruston, Roydon Common, Felmingham.

Anchistropus emarginatus Sars. Sutton Broad.

* Trans. N. & N. Nat. Soc. VI. p. 489.

Copepoda

Calanoida

Acartia bifilosa Giesb. River estuaries (previous record of *A. longiremis* not confirmed).

Paracalanus parvus (Claus) Stokesby, September, 1910.

Parapontella brevicornis (Lubbock) Breydon.

Cyclopoida.

Cyclopina elegans Scott. Estuary of Bure.

Cyclops gracilis Lillj. Larling Heath, 1927.

Cyclops languidoides hypnicola Gurney. In submerged moss, Sutton, Buxton Heath, etc.

Cyclops languidoides eriophori Gurney. Ingham.

Cyclops nanus Sars. Sutton, Felmingham, etc.

Cyclops vicinus Uljanin. This is the common plankton species of the Broads, previously recorded as *C. strenuus*.

Cyclops agilis Koch, *lilljeborgii* Sars, *speratus* Lillj. *macruroides* Lillj. All these "serrulatus-forms," as described by Sars, occur fairly frequently. *C. agilis* is by far the most abundant.

Thersitina gasterostei Pagenst. A common parasite of the Stickleback in rather brackish water.

Harpacticoida.

Alteutha purpurocincta Norman. Stokesby, September, 1910.

Zaus goodsiri Brady. Breydon, June, 1921.

Dactylopusia neglecta Sars. Breydon ; 6-mile House ; Cley.

Stenhelia palustris (Brady) Burgh Castle, Wells, etc.

Amphiascus debilis Giesb. Holkham, Breydon.

Canthocamptus cuspidatus Schmeil. Holt Lowes.

Canthocamptus echinatus Mrazek. Flordon, Buxton, Holt Lowes.

Canthocamptus horridus Fischer. Sutton, East Ruston, Ingham, South Walsham, Breckles.

Canthocamptus weberi Kessler. Newton Common, Buxton Heath.

Canthocamptus zschokkei Schmeil. Sutton, Buxton, Honing, etc.

Moraria brevipes Sars. Newton Common, Buxton, Booton, E. Ruston, Roydon, Holt Lowes.

Moraria arboricola Scourfield. Tree-holes at Felbrigg (Scourfield).

Epactophanes muscicola (Richters) Buxton Heath.

Mesochra aestuarii Gurney. Acle Bridge, October, 1920. Breydon, June 1922.

Mesochra rapiens Schmeil (previously recorded as *Canthocamptus hirticornis*).

Nitocra typica Boeck. Salthouse, Breydon, R. Bure.

Nitocra spinipes Boeck. (*Canthocamptus palustris*).

Nitocra lacustris Schmank. (*N. simplex* Schmeil). Cley; Horsey Mere, Hickling Broad.

Nannopus palustris Brady. Ludham Bridge (fresh water) R. Bure, Cley salt marsh.

Laophonte nana Sars. Breydon.

Platychelipus littoralis Brady. Breydon.

Horsiella brevicornis (Van Douwe). Barton, Hickling, Horsey, Irstead, Calthorpe Broad.

Tachidius incisipes Klie. Reedham.

APPENDIX I

Examples of Water Analyses

1. Well Water. Sutton Broad Laboratory

	Well 40 feet deep Grains per gallon	Parts per 100,000.
Free Ammonia	.0021	.0030
Albumenoid ammonia	.0021	.0030
Chlorine as Chlorides	3.30	4.70
Temporary hardness	9.80 degrees†	
Permanent hardness	5.40 degrees	
Solids in solution	19.10	27.2

Containing suspended Iron Oxide derived from the Crag through which the tube is driven.

2. *Ormesby Broad. 9/4/0c

Chlorine	7.34	10.46
Sulphuric Acid	4.714	6.72
Free Ammonia	.0017	.0024
Organic Ammonia	.10	.1012
Loss on ignition	5.21	7.44
Total solids	37.65	53.68
Permanent hardness		13.80 degrees
Temporary hardness		15.60 degrees

3. *River Bure at Horning. 24/4/06

Sodium chloride	10.37	14.78
Magnesium Chloride	.814	1.16
Magnesium nitrate	.25	.35
Calcium Sulphate	4.43	6.32
Calcium Carbonate	11.26	16.05
Magnesium Carbonate	1.36	1.94
Silica and Iron Oxide	.25	.36

*F. Sutton. Minutes of Evidence, Great Yarmouth and Lowestoft Water Bill. June 26th, 1906, p. 54, 55.

†One degree of hardness = one grain of Calcium Carbonate per gallon.

4. Analysis of Salinity in River Bure

(*a*) March 13th, 1906, after high salt tide.*

	Grains per gallon	Parts per 100,000
Wroxham	... 4.34	... 6.28
Horning	... 409.73	... 583.78
Thurne Mouth ...	... 1294	... 1834
Acle	... 1784	... 2434
Stracey Arms ...	... 1882	... 2577

(*b*) April 25th, 1906. Normal conditions nearly restored.†

Horning	... 8.66	... 11.34
Thurne Mouth ...	... 15.28	... 21.77
Acle	... 18.40	... 26.22
Stokesby	... 32.28	... 46.00
5-Mile House ...	... 398.2	... 567.4
3-Mile House ...	... 980.3	... 1396.9
Mouth of Bure ...	... 1922.5	... 2739.3

*Sutton. Minutes of Evidence. July 27th, 1906. p. 258, table 4.
†ibid. June 26th, 1906, p. 53.

5. Analysis of Water from a Well at Ingham, 1904

	Grains per gallon
Free Ammonia	.0021
Albumenoid ammonia	.0182
Nitrogen as nitrates	2.20
Chlorine in Chlorides	24.50

APPENDIX II.

EXAMPLES OF THE CRUSTACEAN FAUNA OF SPECIAL LOCALITIES

1. East Ruston Marsh

Cladocera

Daphnia longispina
Ceriodaphnia laticaudata
,, *setosa*
Simocephalus vetulus
Scapholeberis mucronata
Lathonura rectirostris
Eurycercus lamellatus
Acroperus harpæ
Alona quadrangularis
,, *affinis*
,, *costata*
,, *guttata*
,, *rectangula*
,, *tenuicaudis*
Kurzia latissima
Graptoleberis testudinaria
Alonella excisa
,, *exigua*
,, *nana*
Pleuroxus aduncus
,, *lævis*
,, *trigonellus*
Chydorus sphæricus
,, *ovalis*
,, *piger*

Copepoda

Cyclops albidus
,, *fuscus*
,, *languidus*
,, *languidoides hypnicola*
,, *nanus*
,, *bicuspidatus*
,, *viridis*
,, *leuckarti*
,, *dybowskii*
,, *rubellus*
,, *bicolor*
,, *varicans*
,, *agilis*
,, *lilljeborgii*
,, *phaleratus*
,, *affinis*
Canthocamptus crassus
,, *staphylinus*
,, *trispinosus*
,, *horridus*
,, *minutus*
,, *gracilis*
,, *pygmæus*
Moraria brevipes

2. Pond on Larling Heath

Cladocera
- *Daphnia longispina*
- *Scapholeberis mucronata*
- *Ceriodaphnia reticulata*
- *Simocephalus vetulus*
- *Macrothrix rosea*
- *Lathonura rectirostris*
- *Acroperus harpæ*
- *Alona affinis*
- ,, *rectangula*
- *Alonella exigua*
- ,, *excisa*
- *Chydorus sphæricus*

Copepoda
- *Cyclops albidus*
- ,, *fuscus*
- ,, *gracilis*
- ,, *varicans*
- ,, *agilis*
- *Canthocamptus trispinosus*
- ,, *minutus*
- ,, *crassus*
- ,, *staphylinus*
- *Diaptomus castor*
- ,, *vulgaris*

3. River Bure at Muckfleet 7/7/06

(A) In weeds by shore.
- *Bosmina longirostris*
- *Diaphanosoma brachyurum*
- *Sida crystallina*
- *Ceriodaphnia quadrangula*
- *Simocephalus vetulus*
- *Eurycercus lamellatus*
- *Alona affinis*
- *Chydorus sphæricus*
- *Cyclops leuckarti*
- ,, *agilis*
- ,, *viridis*
- *Eurytemora velox*

(B) Bottom fauna—brackish-water species
- *Heterotanais gurneyi*
- *Cyathura carinata*
- *Gammarus duebeni*
- *Corophium grossipes*
- *Melita pellucida*
- *Microdeutopus versiculatus*
- *Cytheridea torosa*
- *Nereis diversicolor*

An example of a sedentary euryhaline fauna holding its own at a point in the river where the water is commonly, as on this occasion, fresh at all states of the tide.

4. Sutton Broad

October, 1905. Crustacean fauna of *Sparganium minimum*

Cladocera
- *Sida crystallina*
- *Diaphanosoma brachyurum*
- *Daphnia longispina*
- *Simocephalus vetulus*
- *Scapholeberis mucronata*
- *Ceriodaphnia pulchella*
- ,, *quadrangula*
- ,, *megalops*
- ,, *reticulata*
- ,, *laticaudata*
- *Lathonura rectirostris*
- *Polyphemus pediculus*
- *Eurycercus lamellatus*
- *Acroperus harpæ*
- *Graptoleberis testudinaria*

Copepoda.
- *Cyclops agilis*
- ,, *bicolor*
- ,, *albidus*
- ,, *distinctus*
- ,, *viridis*
- ,, *leuckarti*
- ,, *hyalinus*
- *Diaptomus gracilis*
- *Eurytemora velox*
- *Canthocamptus staphylinu*

Alona affinis
,, *quadrangularis*
,, *rectangula*
,, *costata*
Peratacantha truncata
Pleuroxus lævis
Chydorus globosus
Alonella excisa
,, *exigua*
,, *nana*
Anchistropus emarginatus

5. Examples of "Sphagnophil" Fauna

(A) Buxton Heath. 30/5/27. Squeezing from moss
Canthocamptus weberi
,, *pygmæus*
,, *echinatus*
,, *Zschokkei*
Epactophanes muscicola
Cyclops languidoides muscicola

(B) Newton Common. 13/5/21. Sphagnum pool
Acantholeberis curvirostris
Chydorus ovalis
,, *sphæricus*
Canthocamptus weberi
,, *pygmæus*
Moraria brevipes
Cyclops vernalis

6. Examples of Brackish Water Fauna—Entomostraca

(A) Breydon Water, in Zostera. 5/6/21
Halicyclops magniceps c.c.
Ectinosoma curticorne c.
Dactylopusia neglecta c. (*Ostracoda* omitted)
Nitocra typica
Mesochra lilljeborgii
Nannopus palustris
Platychelipus littoralis
Tachidius littoralis c.

In plankton
Acartia bifilosa
Centropages hamatus
Eurytemora affinis

(B) Horsey Warren. 19/11/20
Old Hundred Stream. Salinity 12.2 grms. Chlorine per litre
Mesochra lilljeborgii
Nitocra spinipes
Adjacent ditch. Salinity 11.6 grms. Cl. per litre
Nitocrs spinipes
Another ditch. Salinity 4.8 grms. Cl. per litre
Cladocera
Acroperus harpæ
Alona affinis
Chydorus sphæricus
Copepods
Cyclops viridis
,, *agilis*
,, *lubbocki*
Mesochra rapiens
Laophonte mohammed
Canthocamptus staphylinus
Ostracod
Cypridopsis aculeata

7. Breydon Water. 1/12/20

Tide beginning to flow. Salinity at surface rising from 56.7 grs. per gallon to 116.9

Fresh-water species (surface)

Daphnia pulex
,, *longispina*
Chydorus sphæricus
Daphnia cucullata
Cyclops agilis
,, *macruroides*
,, *leuckarti*
Diaptomus gracilis

Brackish species

Eurytemora affinis
Cyclops bicuspidatus-lubbocki
Dactylopusia neglecta
Ectinosoma curticorne
Mesochra lilljeborgii
Stenhelia palustris
Laophonte nana
Nannopus palustris
Tachidius brevicornis
,, *littoralis*

8. Ormesby Broad. Plankton. 25/5/28

Phytoplankton (commoner forms)

Melosira varians dom. (*M. granulata c*)
Anabæna Spp. ccc.
Pediastrum boryanum c
Asterionella gracillima r
Ceratium hirundinella r
(*Dinobryon r*)

Rotifera

Anuræa aculeata and cochlearis
Asplanchna priodonta
Notholca longispina

Entomostraca

(figures giving frequency per cent.)

Daphnia lacustris	23
**Ceriodaphnia pulchella*	
Bosmina longirostris ...	60
Diaptomus gracilis	
adult	2
young	14
Cyclops vicinus	
adult	1
**Cyclops leuckarti*	

*These two species were present, but not in the sample measured. They reach considerable numbers later in the year—C. *pulchella* to 53% in September.

9. River Bure at Stokesby

I.	II.
September 3rd, 1910, 12.30 p.m.	Sept. 4th, 4.45 p.m. tide ebbing about 4 hours.
Slack-water of flood.	
Daphnia longispina	*Centropages hamatus*
Bosmina longirostris	*Acartia discaudata*
Ceriodaphnia pulchella	*Cyclopina littoralis*
Scapholeberis mucronata	*Euterpina act uifrons*
Chydorus sphæricus	*Tachidius littoralis*
Cyclops agilis	
,, *hyalinus*	*Oikopleura*
Eurytemora velox	*Hormiphora*
Notodromas monacha	*Noctiluca*
Neomysis vulgaris	*Larval Polychæts, Molluscs and Cirripedes*

Melosira
Conochilus

Two collections taken at the same place within about 24 hours, showing complete replacement of fauna by salt tide.

10. Comparison of the Crustacean Plankton of the Scottish and Cumberland Lakes with that of the Norfolk Broads

Northern Lakes	Norfolk Broads
G—*Daphnia hyalina and galeata* large forms	*D. cucullata*
G—*Bosmina obtusirostris*	*B. longirostris*
	Ceriodaphnia pulchella
G—*Diaphanosoma brachyurum*	
G—*Leptodora kindti*	
O—*Holopedium gibberum*	
G—*Bythotrephes longimanus*	
O—*Polyphemus pediculus*	
G—*Diaptomus gracilis*	*D. gracilis*
O— ,, *laticeps*	
O— ,, *laciniatus S*	
O— ,, *wierzejskii S*	
	Eurytemora velox
G—*Cyclops abyssorum*	*C. vicinus*
	C. leuckarti
	C. hyalinus

G—generally. O—occasionally. S—Scotland only.

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Further investigation of the well at Walsingham from which Niphargus is recorded (p. 573), shows that it is very common therein. The species has now been definitely named by Prof. Tattersall as *N. chianus* Sp. Bate, which is known also from Hampshire, Wiltshire and Dublin. Sir Sidney Harmer's specimens from Cringleford belonged to *N. aquilex*. Associated with the Niphargus were numbers of Cyclops, but these do not belong to any of the true subterranean species. They have not been sufficiently studied, but are apparently *C. languidoides hypnicola*.

III

THE SWAN-MARKS OF WEST NORFOLK

By N. F. Ticehurst, O.B.E., M.A., F.R.C.S.

In order to give a complete account of Norfolk swan-marks it remains to consider those that were used by owners having swans under the jurisdiction of the Deputy Swan-Master for Cambridge, Huntingdon, Northampton and Lincoln, that large area which I have elected for brevity to speak of as the Fenland. This included, as I have already shown, that part of Norfolk whose water drainage entered the Wash (*vide* Vol. XII., p. 426).

There is but little evidence as to the exact locality where the swans marked with any given mark lived. Changes of ownership were frequent, and what may be termed absentee owners were numerous. It can hardly be supposed that on the sale of a mark the birds bearing it were, as a matter of practice, caught up and transferred to the new owner's home waters, and I do not believe that in the vast majority of cases any such thing took place. It follows then that the owner's home did not necessarily coincide with that of his birds. They must indeed have often been a considerable distance apart and may even have been in different counties. Such absentee ownership was recognized and provided for in the Swan "Orders" by the granting of facilities for the appointment of deputies to act for owners at the upping and generally to look after their interests. In the west of the county, which, as we have seen, was only a part of one large swan-keeping

area, these conditions and circumstances must have been much more marked and frequent than in the more restricted and self-contained Broadland area.

Under the circumstances we have to take as Norfolk marks all those whose owners were resident in the county, though it is quite obvious that some of them must have been, and indeed had been originated outside its boundaries. It would be quite possible to divide the marks into three groups. (A) Those of Norfolk origin, which remained in the possession of Norfolk owners. (B) Those of Norfolk origin, which were later alienated out of county ownership; and (C) those of extra-Norfolk origin, which passed into Norfolk ownership. There seems to be no advantage, however, in considering such a classification, as the origin of each particular mark is quite sufficiently indicated in tracing its succession of owners. It is probable, moreover, that it is only in the case of quite a few that material is available for tracing back to the actual first owner.

In working out the changes undergone by the marks in course of time, and the successions of their ownerships, several points strike one. There is firstly the number of proprietors who possessed multiple marks, even up to five or six apiece, *e.g.*, the Megges, Finchams, Bedingfields, Hewars and Hunstons, Robert Everard, Francis Boulton, Sir Thomas Tindall and John Whetholme; and secondly the frequency with which marks changed hands within a comparatively short time. One cannot but suspect that in certain cases swans were kept quite as much, or even more, for profit as for pleasure or prestige. A third point is the remarkable length of time that it has been possible to establish that some marks were in use. Pedigrees of a century are frequent, but those of Nos. 28, 63, 99, 110 and 184 extend to two, while those of Nos. 8 and 9, the Prior of Thetford and the Prioress of St. George, cover 250 years at least, and probably considerably more.

The differences in character, tenure, usage, and method of record between Fenland and Broadland marks have already been dealt with, so it may suffice here just to mention, as examples of the comparative complexity and simplicity of the respective groups, those of proprietors who were owners in both areas, viz., The Duke of Norfolk, the Earl of Sussex, the Earl of

Suffolk (the Countess, in Broadland), the Earl of Oxford, Henry Hawe, Sir James Hobart, Sir Thomas Lovell, Sir Thomas Tindall, William Yelverton, and Mr. Anguish. Curiously enough the list of dual owners also includes a marked exception, Sir Thomas Lovell's Fenland mark being essentially of a simple Broadland type, while Sir Francis Lovell's Broadland mark was distinctly more elaborate. As has already been pointed out those of Henry Hawe and Mr. Anguish were actually Fenland marks transferred at a later date to Broadland. Another exception is the exceedingly simple Fenland mark, almost unique in this area, of Henry Doyle (No. 92). It is perhaps significant that this man was not Fenland born, but a native of Suffolk, and probably took up swan-keeping on acquiring his wife's Fenland estates.

Amongst the marks are certain groups to which special attention may be drawn.

Curiously enough it appears to have been quite unusual for a swan-mark to have been derived from its owner's coat of arms. Several antiquarian writers have remarked on this and have only been able to quote one or two instances. One example was given in my paper on Broadland marks, and amongst the marks that follow some eight will be found that with a considerable degree of probability had this origin, viz. :—The Earl of Leicester (No. 22), Robert Balam (No. 37), Everard (No. 104), and Edmond Gawsell (No. 105), Thomas Guybon (No. 126), Humphrey Kervyle (No. 151), Reppes (Nos. 196—200), and Steward (Nos. 212 and 213). Then there are examples of foot- and leg-marks, *e.g.*, Robert Balam (No. 38), John Drewry (No. 158), and Francis Parlett (No. 186). Though fairly numerous in the Fenland generally, it so happens that these are the only Norfolk ones. As already pointed out this form of marking was not used in Broadland. Neither was it used on the Thames, but it was frequent in Yorkshire and examples are also to be found from the Trent, the Sussex Arun, and the Dorset Stour.

Thirdly, we have examples of lower mandible marks in No. 99 Thomas and William Coney, No. 115 Francis Gardener, No. 116 Gawsell, No. 121 John Grendell, No. 128 Reppes, and No. 167 Robert Fincham, quite a good proportion considering that their use was dying out in Elizabethan times. They

must have always been an unsatisfactory method of marking, requiring close handling of the bird to be seen, but were very frequent up to the beginning of the sixteenth century in the Fenland. Beyond the single example given in my Broadland paper I can find no evidence of their use elsewhere.

Fourthly, amongst the marks of the religious foundations we have one representative (No. 12) of a small group of Fenland Churches, in which the swan-rights appear to have belonged to the living, while a second (Thomas Gardener, No. 114) also originally belonged to the same group. With them special mention must be made of Nos. 13, 14 and 15, once owned by certain of the village Guilds. Except for the one Broadland example already given, and one from the Thames, this particular tenure is only known from the Fenland, and Norfolk can claim half the total.

While on the subject of the marks of religious houses mention may be made here of two that have been lost, or at any rate cannot now be identified. This is much to be regretted for they both go back to a very early period, the first indeed being the earliest that I can find mention of. It is referred to in a deed which Blomefield appears to have seen and which he quotes in the course of his remarks on the manor of Cokesford in Kilverstone (*H. of Norfolk*, Ed. II., vol. I., p. 544). "In 1230, there was a dispute between Richard, Prior of Thetford, and William, Prior of Cokesford, concerning their separate fisheries belonging to their manors here; 'concerning the use and propriety of all the fishing lying between the territory of Snareshill, and the territory of Kilverstone, the Prior of Thetford claiming the whole of the water or river from his mill called Melford Mill, to the extent of his town of Snareshill', viz., the whole of Snareshill side, as belonging to his free fishery there, and this side, as belonging to his manor here; but the Prior of Coxford having a free fishery to his manor here, claimed an equal share on this side; and it being proved to be so, the Prior of Coxford let his right for ever to the Prior of Thetford for 8s. a year. But the Prior of Coxford reserved to himself his swan-mark, belonging to his manor, throughout the whole river, with liberty to gather reed and grass at all times in the said river, with the consent of Richard, Bishop of Norwich."

Blomefield goes on to state that there was then (1736) a

swan-mark belonging to this manor. If this was the same mark, as to which there is no evidence, it would constitute a remarkable record of use for over five centuries. The manor passed through the hands of only three families after the dissolution, the Duke of Norfolk, the Cornwallis's and the Wrights of Kilverstone. The latter purchased it in 1587, so that if they used the swan-mark the name Thomas Wright ought to be found on a swan-roll somewhere. So far it has not come to light.

The second early mention of swan-keeping concerns the little Priory of Mirmound in the parish of Upwell, and must refer to very much the same date. The Priory was founded in the reign of Richard I. (1189-1199) by Sir Ralph Hauvyle and was endowed by him with certain property in Upwell and Outwell. "Sir Thomas, his son and heir, confirmed the same, and granted liberty of pasture for four mares with their foals; also four couple of swans, paying 5s. rent per annum" (*t.c.*, vol. VII., p. 477).

Fifthly, attention may be drawn to the colloquial names by which certain of the marks were known. Of these there are quite a number of instances. I have remarked elsewhere (*Brit. Birds*, Mag. XIX., p. 294) that most marks probably had names by which they could be spoken of or written about, but that few of them have come down to us. Most of them are curious and seem somewhat far-fetched as descriptive of the marks, and not a few are incomprehensible. This may to a slight extent in one or two cases be due to faulty reading, as the ink in the MS. from which they were taken is very faded in places. One or two are obviously abbreviated and must be guessed at, but others about which there can be no error seem to be old provincialisms, whose meaning is not at all apparent. I need not add that any suggestions as to the meaning of these would be welcomed by the writer.

The material on which this paper is based is derived from the following nineteen rolls:—Additional MSS. 4977, 6301, 6302 and 40072, Harley MS. 3405 and Egerton MSS. 2412 and 2413 in the British Museum; MSS. Rawlinson B42 and B277 in the Bodleian Library, The Colvile and Wisbech Museum Rolls in the Wisbech Museum, the Bromhead Roll in the Public Library at Lincoln, the Roll in the Public Record Office and the

Stow Bardolph, Cooper, Marriott, Burghley, Swatman and Towneley Rolls. I must here record my indebtedness to the custodians of the different public institutions named, as well as to Sir Thomas Hare, Bart., (the late) Mr. Henry F. Cooper, the Rev. H. S. Marriott, the Marquis of Exeter, and Messrs. Quaritch for the facilities they have granted me for examining the rolls in their several possession. Of the above, the Colvile and Bromhead Rolls are modern copies, all the others are original documents. All are books except the Public Record Office Roll and Add. MS. 40072. The Public Record Office Roll, MS. Rawlinson B277 and the Colvile Roll show the whole of the birds' head in profile ; the others the bills only in plan. The same three with MS. Rawlinson B42 and the Wisbech and Towneley Rolls only are coloured. Egerton MS. 2412, the Stow Bardolph and Towneley Rolls are on paper, all the others on vellum.

Besides noting all those cases where marks from different rolls are quite identical and recording their owners' names, it has been necessary to draw and note the ownership of over 870 that differed sufficiently to convince one that the variations were intentional and of purpose.

In arranging the marks in the annexed list I have followed the general order of the rolls, the Royal marks coming first, then those of the Religious foundations and allied bodies, those of Peers and then those of Commoners in alphabetical order. It has thus been necessary to assign each mark to a single owner and, so far as it has been possible, I have awarded it in each case to the earliest certain Norfolk man to own it. It must be obvious nevertheless that in dealing as we are with a considerable period of time and with the constant changes of ownership that were taking place both within the county and outside it, the owner given is frequently not the actual earliest. With regard to the owners themselves there must inevitably be cases where information about them is not as full as is desirable and I shall be only too grateful for any help or suggestions for filling up gaps in this respect. Many owners no doubt belonged to the yeoman class, or to well-to-do merchant families, and details of their pedigrees seem to be hard to gather. In particular more exact information is desirable about the numerous owners who were citizens of King's Lynn,

but especially I should like to know more about the families of Damett, Lambert, Laverocke, Megges, Norman and Walsingham, who were all settled in the Upwell-Outwell district.

1, 2, 3, 4. These four were the royal marks used in the Fenland. Nos. 1 and 2 were used throughout the whole area, and are probably the oldest. No. 2, known as the mark of the Sword, was restricted in use to Swans belonging to the manors of the Duchy of Lancaster. These two are found on every Fenland roll except the one at Stow Bardolph, which only catalogues the marks of owners having Swans in the waters on either side of the Norfolk-Cambridge Ouse. The royal marks given on this and on some other rolls are Nos. 3 and 4, so that it seems probable that these were restricted in use to the southern half of the Fenland. No. 3, which goes back at least as far as the reign of Henry VIII., was used then with a gap at either extremity of the inverted chevron; as drawn here it dates from the reign of Elizabeth. In Stuart times it was restricted in use to the Swans owned by the Queen Consorts. No. 4, which remained in later use for the birds of the Stuart Kings, antedates the accession of Elizabeth and so from its character and obvious origin cannot be of later date than the reign of Edward VI. and may of course be even older.

5. The Prior of Castleacre.—After the dissolution this mark became the property of Arthur Hewar of Oxborough (*vide* No. 131) and then of Thomas Welby of Sutton in Holland and so passed out of Norfolk ownership.

6. Castleacre Priory.—After the dissolution this mark also passed out of Norfolk ownership. It was granted to William Thomasin of Parson Drove, who was alive in 1549, and after him was held by a succession of proprietors, who belonged to the Wisbech area.

7. The Abbot of Dereham.—The mark belongs to a very small class in which a reference is traceable to the owner's calling. This one and the mark of Swineshead Abbey in Lincolnshire are the only two examples in the Fenland that contain a representation of an Abbot's staff. On the Thames nearly every monastic house adopted this as part of its mark. After the dissolution this mark passed with the grant of the

site of the Abbey to Thomas Dereham of Crimplesham in 1541 and seems to have continued in his family (*vide* No. 85).

8. The Prior of Thetford.—Martin (*Hist. of Thetford*, p. 293) in giving this mark as that of "The Prior of the Canons', now Lord Petre's" is clearly in error, and this double title is in a sense contradictory. Two swan-rolls give this mark quite distinctly for the Prior of Thetford, *i.e.*, the Prior of the Monastery of the B.V. Mary. After the dissolution the possessions of this house were granted to the Duke of Norfolk, under whose name the mark is to be found on six other rolls. Robert Edward, 9th Baron Petre, who married in 1762 Anne, the niece, and in 1777 one of the co-heirs of Edward, 9th Duke of Norfolk, would quite probably have been the owner at the time of publication of Martin's *History* (1779). The possessions of the Canons of Thetford, as Martin himself states, were granted to Sir Richard Fulmerstone (*vide* Nos. 10 and 113).

The modern roll in the Castle Museum gives this mark for J.S.N.N. Skipworth, and its inclusion in this roll presumably indicates that it was transferred at the end of the 18th century to the Broadland area.

9. The Prioress of St. George, Thetford.—The ascription of this mark to the Prioress of St. George is on Martin's authority, for on the swan-rolls it appears under no other name than that of Sir Richard Fulmerstone, to whom the possessions of the Priory were granted at the dissolution. He seems to have varied the position and number of the gaps from time to time and to have added an annulet at the right tip, presumably for use in different waters or in order to keep account of the birds' ages and relationships. In 1771 Martin tells us that the mark then belonged to Henry Campion.

10. The Canons of St. Sepulchre, Thetford.—This mark is also taken from Martin, and is not to be found as here drawn and named on any swan-roll that I have seen. I am of opinion, however, that marks Nos. 113 and 72 *infra* are direct derivatives of it and show two successive steps in "differencing." The possessions of the monastery were granted at the dissolution to Sir Richard Fulmerstone, whose modification of the mark is given at No. 113.

11. The Hospital of St. Mary Magdalen, Gaywood.

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FIGURE 1

12. The Church of St. Clement, Outwell.—This is the only Norfolk member of a group of some six or eight south Fenland Churches that anciently possessed a swan-mark and whose ownership seems to have been vested in the living. What became of this one after the dissolution is not recorded.

13. The Guild of St. John, Upwell.—After the dissolution this mark was owned by Thomas Hilbrande, whom I have not identified, and then by James Hobart (1524-1615), who succeeded to Hayles Hall in Loddon in 1561. Both "differenced" the mark by adding a gap within the lateral square.

14. The Guild of St. Clement, Upwell.—After the dissolution it was used in succession by the Townsend and Pratt families, presumably of Rainham and of Hockwold, or Ryston, respectively, but as no christian names are giving, identification must be uncertain.

15. The Guild of the Holy Trinity, Walsoken.—The ownership of this mark after the dissolution is not recorded.

The last three marks are an interesting group and, together with the Stalham one given in my Broadland paper, make four out of the total of eight that are known to have been owned by these old village Guilds. Of the remainder, no place name is given with one, two belonged to Croyland in Lincolnshire and one to Holme in Huntingdonshire.

16, 17. The Duke of Norfolk.—No. 16 was probably, at any rate originally, not used in Norfolk waters, as it belonged to Lord Willoughby D'Eresby and then passed by the marriage of Catherine, Baroness Willoughby, to her husband Charles Brandon, Duke of Suffolk, who died in 1545, possessed, like the Lords Willoughby, of large estates in Lincolnshire. How it subsequently became owned by the Duke of Norfolk does not appear. As originally used by Lord Willoughby the mark included a gap on the left side at the tip of the bill. No. 17 seems to have been the family mark of the Howard Dukes of Norfolk.

18. The Earl of Sussex.—Sir Robert Ratcliffe of Attleborough, Lord Fitzwalter, was created Earl of Sussex in 1530, and the title continued in his family till 1641. How far back the use of the mark extended is uncertain. The Dukes of Norfolk and the Earls of Sussex both had large possessions

in Norfolk and owned Swans in both the Broadland and Fenland areas. As was usual in such circumstances each used quite different marks in each area. A comparison of the two sets illustrates very well the comparative simplicity and complexity of the two types.

19. The Earl of Wiltshire.—Sir Thomas Boleyn of Blickling, created Earl of Wiltshire in 1529, was Steward of the Duchy of Lancaster for Norfolk, Suffolk and Cambridgeshire and died in 1539, when the title became extinct. What afterwards became of the mark is unknown.

20, 21. The Earl of Oxford.—No. 20 appears to have been the original mark of the de Veres, Earls of Oxford, but how far back its use extended is unknown. In the seventeenth century it belonged, presumably having been sold, to a family named Parris, perhaps the Cambridgeshire one of that name.

No. 21 is a mark of considerable antiquity, the earliest owner being an unknown named Davies. He was succeeded by Earl Rivers, a title that became extinct at the death of Richard Woodville, 3rd Earl in 1491. The first Earl of Oxford to own it therefore was probably John, 13th Earl, who died in 1513. They owned large estates in West Norfolk especially in the Marshland division, where no doubt their Swans were kept and whither presumably the Swans marked with No. 21 were imported by them from Northamptonshire about the end of the fifteenth century. The later owners would have been John, 14th Earl, 1513-1526; John, 15th Earl, 1526-1539; John, 16th Earl, 1539-1562; Edward, 17th Earl, 1562-1604 and Henry, 18th Earl, 1604-1625.

22. The Earl of Leicester.—Robert Dudley, created Earl of Leicester in 1564, died 1588, was connected with Norfolk by his marriage with Amy, the daughter of Sir John Robsart of Siderstone. His mark is of interest because of its heraldic origin, having been taken from his well-known Badge of the ragged staff.

23—26. William Atkin, of King's Lynn, Mayor in 1619. Nos. 24 and 25, evidently variants of one another, are only found on a single roll and so probably had no earlier owner. No. 23 had previously been owned by someone named Bayston and No. 24 by Robert Raymond and William Stalton, whom

I have failed to identify, though I suspect that all three were also citizens of Lynn.

27. THOMAS ATTHOW, of Well Hall, Beechamwell and King's Lynn, Sergeant-at-law. He presided at a Court of Swan-mote held at Wisbech in 1578, whose proceedings are recorded in a manuscript in the Bodleian Library. This mark had previously been owned by James Boulton, whom I have not been able to find.

28. JOHN ATTHOW, SENIOR, of Brisley.—This mark had a long succession of owners, John Harrison of Soham, Cambs., who died in 1541; the Faunts, presumably of Foxton, Leicester, though originating at Whistow in Huntingdonshire and possessed of a family mark of their own; then the present owner, who seems to have been the first Norfolk man to hold it. He cannot have held it long, for early in the seventeenth century (or before) it belonged to the Fennes, who were considerable landholders in Wiggenhall, Tilney, Terrington and Lynn at that period. It first belonged to William, whether that one who was at Wiggenhall in 1589 I am not sure, but it came to Thomas Fenne in 1622 and evidently continued in the same family until the failure of the male line, when it passed by marriage to the Harwicks of Eaubrink and was held by Fenn Harwick in 1710.

29, 30, 31. PHILLIP AUDLEY, of Palgrave Magna, born before 1563, alive in 1592. All three marks had previously belonged to the Lords Dacres of the South. There is no evidence as to how the Audleys became possessed of them, but perhaps they were allowed by grant from the crown to Phillip, or more probably his father Edmund, after the attaint and execution of Thomas Fiennes, 9th Baron Dacres, in 1541. His son Gregory was not restored to his honours until 1558. In most instances the marks are recorded under the surname only and Phillip is the only member of the family definitely given anywhere, so that we do not know whether Edmund held the marks or not. Phillip died without male issue and they were subsequently owned by Lord Thomas Howard, who was created Baron Howard de Walden in 1597 and Earl of Suffolk in 1603.

32, 33. BADGECROFT, of Bexwell.—Nowhere is any christian name given with either of these marks, but No. 33 was probably the original family mark as it never occurs under

any other name. In some rolls the mark is drawn as here, with annulets, and in others with roundels, presumably a method of "differencing." No. 32 had an earlier owner, Thomas Vowell, whom I have failed to find, though there was a family of that name connected with Creke Abbey, of whom William was alive in 1551. One of the Badgecroft owners must have been Richard, who died in 1549, for on three rolls a later owner, Skipwith, is given. There cannot be much doubt therefore that Richard devised the mark to his daughter Ellen, or to her husband William Skipwith of Snowre Hall in Fordham, who died about 1588. He "differenced" it by moving the design to the opposite side of the bill. One of his descendants used it on both sides at once.

34. Edward Baker, of King's Lynn, Common Councillor in 1523 and 1537 and Mayor in 1540, died 1540. A second Edward Baker was Mayor in 1550. This mark was held by a succession of Lynn families of whom the Bakers seem to have been the earliest. Thomas Waters, who was Mayor in 1551 and 1558 and M.P. in 1542 and 1553-57 succeeded and was followed by Segrave and Fenne (no christian names given), John Atthow senior of Brisley (*vide* No. 28) and Thomas Atthow, sergeant-at-law (*vide* No. 27).

35. William Baker, of East Walton.—There were two earlier owners of this mark, Robert Sumpter and Thomas Boyes, but I cannot find either of them. The former used it with the addition of a gap at the left base, while the latter used it with a gap on the left, half way down the bill, a semi-circular mark opposite to it, and no annulet.

36. Richard Baker *alias* Ladde, of Terrington, who was alive in 1558 and 1590.

37. Robert Balam, of Walsoken, alive in 1547. He succeeded to this mark from his uncle Alexander, who was a Wisbech man, Alderman of the Guild of the Holy Trinity there in 1524-5 and 1531-39, and died without issue. It is probably derived from the family arms, though altered in the process, the fesse being changed into a bend. The arms were :—Sable, on a fesse between three estoiles argent as many pellets.

38. Robert Balam, *idem*.—This mark originally belonged to Thomas Maltiward of King's Lynn, who was alive in 1548,

and was obviously compounded of his initials. It must be presumed to have been purchased from him by Robert Balam, who added the foot-mark and the gap by way of " difference." From him it descended to his first cousin and heir John Balam of Barton Mills in Suffolk, and so to his son Alexander of Beaufort Hall in Elm, Isle of Ely.

In the inscription, describing the foot-mark, " heele " means the hind-toe, a comparatively degenerate structure in the Anatidœ and one whose loss would have been no detriment to the bird. Curiously enough not one roll states which of the two hind-toes had to be removed.

39. Thomas Barrow, of Shipdam.—The mark was " differenced " by one of his successors (christian name not given) by adding a gap at either end of the larger triangle. An earlier owner was William Wolsey, whom I cannot identify.

40. Nicholas Beaupre, of Beaupre Hall, Outwell, d. 1513. There is no record of this mark having descended to his son Edmond, but it evidently did so as it afterwards followed the same succession as his marks, Nos. 41 and 42, to Sir Robert Bell and his son Sir Edmund. A mark which is almost indistinguishable from this one is recorded on several rolls for Robert Hall of Outwell or for Thomas Rearby, but I have failed to find any particulars about either of them. The mark was known by the name of " ye acr stafe and shard." Acrestaff is another name for plough-staff and I suspect that shard is a misreading for share.

41, 42, 43. Edmond Beaupre, of Beaupre Hall, son and heir of Nicholas (No. 40) whom he succeeded in 1513. At his death in 1567 he left his daughter Dorothy his heir. In 1559 she had become the third wife of Robert Bell, Sergeant-at-law, who was knighted in 1576 and made Chief Baron of the Exchequer in 1577, dying the same year at the Black Assize at Oxford. Their son Sir Edmund Bell succeeded to the Beaupre Hall estates together with marks 41 and 42.

No. 43 is only recorded for Edmond Beaupre, unless No. 84 *infra*, given on every roll for Deane is a " differenced " variant of it.

No. 41 was known by the name " sp. graynes " and No. 42 as " ye chevins," as to the meaning of which I am unable to offer any suggestions.

44—48. Sir Edmund Bedingfield, of Oxborough, knighted 1523, died 1553. It is possible that some or all of these marks belonged to an earlier owner of the same name, but I take this man as being the earliest certain one. Nos. 46 and 47 are catalogued for him only, but the others, as they occur on different rolls, give, except for one generation, a complete succession of the Oxborough family, viz. :—Sir Henry, who was knighted in 1548 and died in 1583, Edmond who succeeded him and died in 1585 and (Sir) Henry, who succeeded as a minor in 1590 and died in 1657. Thomas his father, who succeeded in 1585 and died in 1590, does not occur. Nos. 44 and 45 are obviously variants of one another and were perhaps created by Sir Edmond or one of his predecessors from a still earlier original. There can be no doubt however that they were used as distinct marks, probably in different waters, as they occur together on several different rolls and each was further "differenced" by successive owners. Thus, Sir Henry added an additional gap at the middle of the left margin to 44, Edmond omitted the annulet and distal gap and the later Henry omitted the distal gap in No. 45.

49. Bedingfield, of Oxborough.—This mark is probably a later-made variant of No. 45. It occurs on two rolls, as here drawn with the two basal gaps on the right, but in neither case is any christian name given. The probability is, however, that either Edmond (1583-5) or Thomas (1585-90) originated it. Sir Henry, who succeeded in 1590, was Sheriff of Norfolk in 1620 and died in 1657, used it with the gaps omitted.

50. Anthony Bedingfield, of Holme Hale, *viv.* 1559. His son and heir Lawrence "differenced" the mark by moving the gap to the right-hand end of the basal bar.

51. John Bedingfield, of Quidenham, d. 1545, a nephew of Sir Edmund Bedingfield of Oxborough. The mark was also used by Humphrey his son, who sold Quidenham in 1572 and moved to Wiggenhall St. Mary, being still alive in 1584. He "differenced" it by placing the gaps on the left side one in front of and one behind the distal cross-bar, as in No. 52.

52. Edmond Bedingfield.—It is difficult to decide the identity of this owner, as several people of the same name are possible. The mark is obviously a variant of No. 51, and it is not improbable that Humphrey sold it (he had no male heir to

succeed to it) when he disposed of Quidenham in 1572. Edmund Bedingfield of Eriswell, his second cousin, who succeeded to the Oxborough estates in 1583, may have been the purchaser. At the beginning of the seventeenth century it belonged to Robert (or Roger ?) Hobart, whom I cannot find.

53. Richard Binknorth.—The name also occurs as Binkworth and Bukworth on different rolls, but Martin (*t.c.*) gives it as here spelt. The owner was presumably a Thetford man and bequeathed the mark to the Town, since it was afterwards the Corporation mark.

54. Richard Binknorth, *idem*.—This mark passed to Sir John Springe of Hitcham in Suffolk (knighted 1546, died 1547) and was afterwards one of four used by Thomas Gray of Wisbech (d. 1593-4), and so for about half a century it passed out of Norfolk ownership. After Gray's death, however, it became the property of Francis Parlett of Wiggenhall, who was Recorder of Lynn, and died in 1605. By a process of exclusion I believe this mark to be the one referred to in Gray's will by the name of "the Bowne Copelles or Copell Spares," the meaning of which is obscure. It was devised to his nephew Henry Gray after the death of Ralph Gray testator's uncle. Shortly after it was the subject of proceedings in the Court of Chancery in which Henry Gray was plaintiff and William and Francis Parlett defendants (*Cal. Proc. in Chanc. temp* Eliz., vol. I). In the *Calendar of Proceedings* the result of the action is not given, but Francis Parlett evidently obtained possession, as the mark appears on several rolls under his name and is nowhere given for either Ralph or Henry Gray. In the *Calendar* the name of the mark is written "Bound Coples or Copled Sparres." As used by Sir John Springe it was "differenced" by the addition of a small cross placed centrally between the cross-bar and the gaps.

55. Francis Boulton, of Burston, married in 1571, dead before 1583. Although resident outside the Fenland area this man was a very extensive owner of Swans and possessed no less than six marks. His son Edward died without issue and they seem to have been dispersed to other owners. The present one passed to Edward Hudson of Castleacre and then to John Elkin, whom I have not identified.

56—58. Francis Boulton, *idem*.—Neither 56 nor 57 are

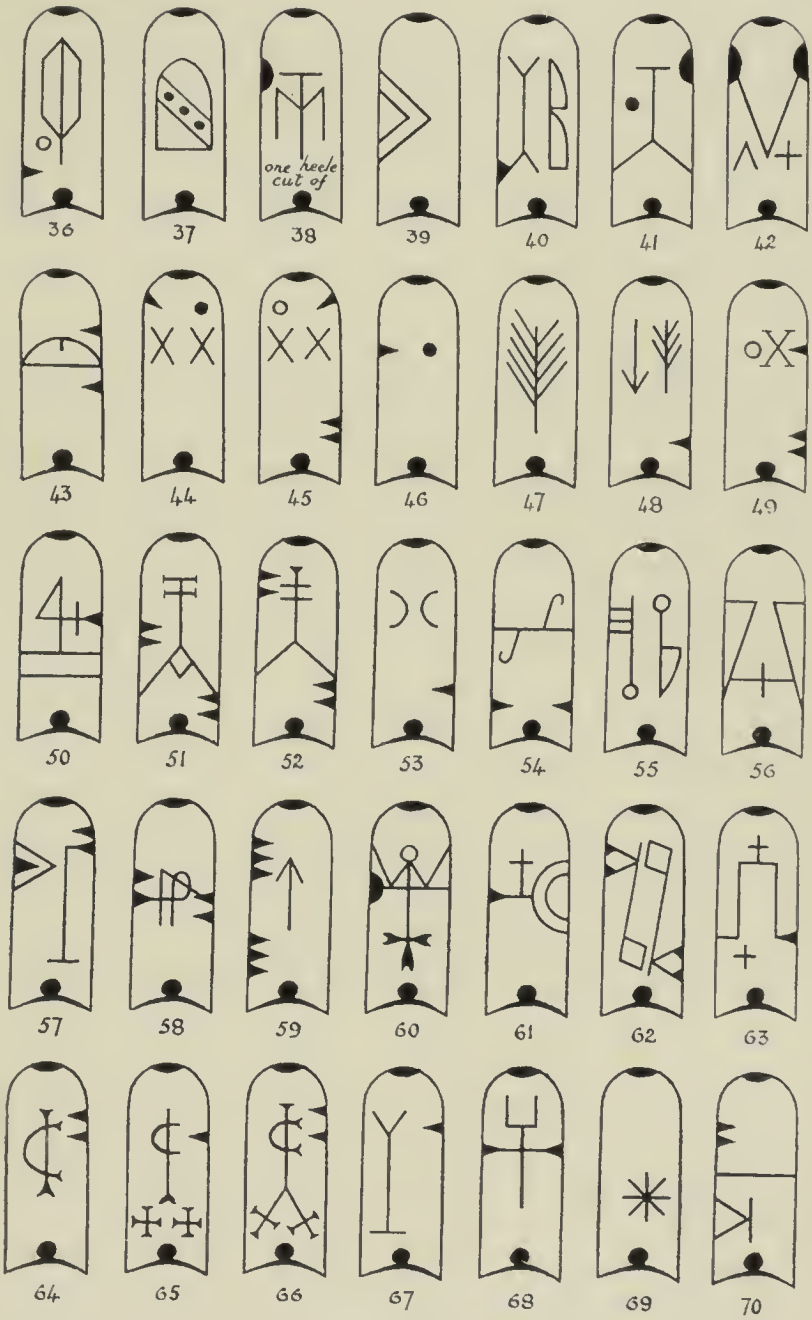
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FIGURE 2

catalogued for anyone else, but No. 58 passed out of Norfolk ownership becoming the property of Sir John Stanhope of Harrington, Northants., who was created Baron Stanhope in 1605, and died in 1620. It was known by the name of " ye wrangle " and whether there be any connexion or not it is identical with the device, which combined with his initials, was used by William Caxton, first at the beginning and later at the end of the books printed by him ; see Plomer, *English Printers*, where it is stated to be a monogram of the date 1474. (For Francis Boulton's other two marks, *vide* Curson, Nos. 77 and 78).

59. Thomas Bradbury, of Ashill, *viv.* 1571.—On most rolls no christian name is given, but the mark evidently belonged to a succession of owners of this family. One of them " differenced it by adding a fourth gap to the distal group of three ; another by transferring all six to the right side of the bill, while a third grouped them all together in a continuous series.

60. John Bull, of Hockwold, Bailiff and Farmer of Methwold Warren under the Duchy of Lancaster in 1550. After his death it was used by his son Edward Bull, who apparently sold it to Thomas Wattes of Cockfields Manor, Hockwold, who owned it in 1609.

61. John Bull, *idem.*—This mark was presumably devised to his daughter Joan, for it is recorded in one roll for her husband, Leonard Barrett of Deforden, Cambs. Like No. 60 it was afterwards acquired by Thomas Wattes.

62. Robert Butler, of Walpole, d. 1630.—There was a succession of earlier owners of this mark, Richard Field, Blinkhorne, and John and Robert Rodgman, but I have not succeeded in identifying any of them. It was alienated to Robert Butler about 1610. After his death it belonged to the Coneys of Walpole, but is nowhere recorded with a christian name.

63. Robert Butler, *idem.*—This too had several earlier owners, Richard and Robert Gibson and John Keye, who although unidentified were almost certainly Lincolnshire people. Butler's immediate predecessor was John Wright, from whom he acquired the mark by his marriage with Elizabeth, either John's daughter or widow. Like No. 62 it passed after Butler's death to the Coneys of Walpole, the earliest

recorded of whom is Robert, who was born in 1633 and died in 1707. He dropped the gap by way of "difference." The last recorded owner is his grandson Edwin, who was Sheriff of Norfolk in 1734 and died in 1755, aged 68. He "differenced" by omitting the cross and adding an ⍝, evidently derived from his christian name, centrally placed, proximal to the main design

64. James Calthorpe, of Cockthorpe, died about 1558.

65, 66. Calthorpe.—These two marks are evidently successive elaborations of No. 64, and form an interesting example of the evolution of a somewhat complicated mark from one that began as a simple monogram of the original owner's initials. Unfortunately the latter two are nowhere given with a christian name attached, so that it is not possible to be sure who made the changes. The original James, however, was succeeded at Cockthorpe by his son Christopher, his grandson Sir James who died in 1615, aged 57, his great-grandson Christopher, who died in 1625, and his great-great-grandson James, alive in 1643, which brings us near to the end of the period with which the swan-rolls deal.

67. Calthorpe, *idem*.—This mark was originally the property of Robert Wright, whom I have not identified, but as his name appears in the Stow Roll, he was probably a Norfolk man, or perhaps the London man of that name who owned property in Thetford in 1555. It was then held for a time by Robert Tigh of Deeping St. James in Lincolnshire and subsequently came to the Calthorpes and after to the Walpoles, presumably of Houghton.

68. Gregory Carter, of West Walton, *viv.* 1564.

69, 70. Richard Clarke, of King's Lynn, Collector of the Port, Alderman and M.P. 1586 and 1588, died 1603.

71. John Clarke, of King's Lynn, Mayor in 1606.

72. Sir Edward Clere, of Blickling, Sheriff of Norfolk in 1567 and 1580, knighted 1578. This is the mark, "differenced" by the addition of the two short bars at the tip of the bill, which came to him through his marriage with Frances, the daughter and heir of Sir Richard Fulmerstone, who died in 1566. He in turn had succeeded to it on acquiring the property of the Canons of St. Sepulchre at Thetford (*cf.* Nos. 10 and 113).

Being an absentee owner, Sir Edward Clere, appointed John Tirrell to act as his deputy to look after his Swans in Fenland waters. The original appointment, dated May 24th, 1576, was formerly amongst Martin's MS. collections.

73. Francis Colvile.—Although the Colviles of Newton Hall near Wisbech were not strictly speaking a Norfolk family they owned at one period large properties in Marshland. Francis, who died in 1494 possessed of manors in Walsoken, Walton and Walpole, was the original owner of this mark, but his successors cannot be traced as it is nowhere given with any other christian name.

74, 75. Humphrey Coney, of Wiggenhall St. Peter.—Both these marks are given on most rolls, but in nearly every case under the surname only or as "Coney of Marshland." Humphrey, who died some time before 1581, is the only member of the family definitely mentioned. No. 74 was at one time owned by the Hartes, presumably of Walpole, but whether before or after the Coneys is uncertain. In the seventeenth century it belonged to Richard Reynolds, at present unidentified.

76. William Coningsby, of Eston Hall, Wallington, which he bought in 1525. He was Recorder of Lynn, was knighted on being made a King's Bench Judge in 1540 and probably died in the same year. The mark occurs on many rolls under the surname only, so there is no evidence as to whether it was used by his son Christopher or not, and what became of it after the latter's death without issue in 1547 is unknown. It appears to be a rather striking elaboration of the owner's initials.

77, 78. Robert Curson, of Carleton Rode.—After his death both marks became the property of William Boulton of Boyland Hall in Bressingham, who had married Robert's daughter and heir Elizabeth. From him they passed to his son Francis of Burston (*vide* No. 55). No. 78 was differenced by the Boultons by transferring the gap to the opposite side of the bill. No. 77 was afterwards owned by John Wingfield, perhaps John of Winch (*vide* No. 234), while 78 went to James Boulton, but what his relationship was to Francis, who had no surviving son, does not appear.

79. William Damett, of Upwell, d. 1527.—The mark went from him to Thomas Welby of Moulton in Lincolnshire and so passed out of Norfolk ownership.

80. William Damett, *idem*.—This mark, known by the name of the "Dobyll byll," was afterwards owned by the Laverocks of Outwell. The only one of them definitely named is John, and he "differenced" it by moving the two gaps on the left close together near the tip of the bill and omitting the one on the right.

81, 82. Damett.—Presumably these marks belonged to William or to some other member of the Upwell family, though no particular one is mentioned on any roll. No. 81 is not given for any other owner, but No. 82 passed to John Peyrse (also spelt Perys, Perris, Perry, Perse or Percey !) of Northwold and his son Robert after him.

83. William Day, of Feltwell, who died about 1548. The mark, known by the name of "ye sheris nedill and thm" (presumably "thimble"), was earlier the property of Robert Sumpter, whom I have not identified. Robert Day of Feltwell, alive in 1605, afterwards owned it and it subsequently went to John Wace of Feltwell, who died in 1672.

84. Deane.—This mark, though it occurs on every Fenland roll, is nowhere given with a christian name attached, but there can be little doubt that it belonged to the Deanes of King's Lynn, Wiggenhall and Tilney. Successive members of the family "differenced" it by altering the position of the gaps on the right edge of the bill, or by omitting the cross. It is not improbable I think that it is a derivative of Edmund Beaupre's mark No. 43.

85. Thomas Dereham, of Crimplesham, who was granted West Dereham Abbey in 1541 and died in 1554. Though it is quite certain that the mark goes back to this owner, it may be a good deal older, as there were three generations of Thomas's before him, the earliest of whom was alive in 1404. One roll in fact gives the owner as John Dereham, and if this is not an error for Thomas, it would carry it back a generation further still. Sir Thomas Dereham, who was knighted in 1617 and died in 1645, Thomas's grandson, used the mark "differenced" by the addition of a gap on each side opposite the centre of the catherine wheel.

86, 87. John Dethicke, of Wormegay, which was granted him in 1540. No. 87 is not given for any other owner, but No. 86 was used by his son Edmund, who died in 1566, after

which there is a gap in the succession, though the fact that seven rolls give the mark under the surname only probably represent further generations of the Dethicke family. Early in the seventeenth century, however, it passed to Robert, 3rd Baron Rich, who was created Earl of Warwick in 1618 and died the same year. He owned the manors of West Winch, Little Buckenham, Hilburgh, the Abbot of Dereham's manor in Barton and Overhall in Boughton, all in the Fenland part of Norfolk.

88. Edmund Dethicke, of Wormegay, d. 1566, son of John, No. 86. After his death the mark probably passed to one of his sons, for three rolls give it under the surname only, but "differenced" with an additional gap at the right-hand end of the cross-bar. It afterwards became the property of Francis Gawdy of Wallington, who was knighted in 1603, made Lord Chief Justice of Common Pleas in 1605 and died in 1606, after which it passed like No. 86 to the Earl of Warwick.

89. William Dicher, of King's Lynn.—Earlier owners were Robert and Richard Blewitt and Robert Knight, whom I have not identified. They may have been, but I am inclined to think were not, Norfolk men. The mark was also owned at one time by Audley Baker of Terrington, who died before 1646, but whether before or after William Dicher is uncertain.

90. John Diggle, of Walpole, *viv.* 1564.

91. James Downes, of Bodney, alive in 1558 and dead before 1571. The mark occurs in eight rolls under the surname only, in three of them without any gap and in two others with two gaps, so that it probably descended to James's son Thomas, who was alive in 1615 and the latter's daughter Elizabeth.

92. Henry Doyle, of Pondhall, Suffolk, knighted in 1546, died 1564. It is noteworthy that this mark, almost unique in character in the Fenland and so typical of Broadland, was not originated by a Fenland man. He presumably became an owner of Swans on the Fenland property of his wife, Jane the daughter and heir of William Elwyn of Wiggenhall St. James.

93. William Dunthorne, merchant, of King's Lynn.

94. John Edwards, of Thetford, Mayor 1582-3.

95. Robert Everard, of Walpole, who lived in the time of Henry VIII., was a very considerable swan-owner and possessed at different times at least five marks. The present

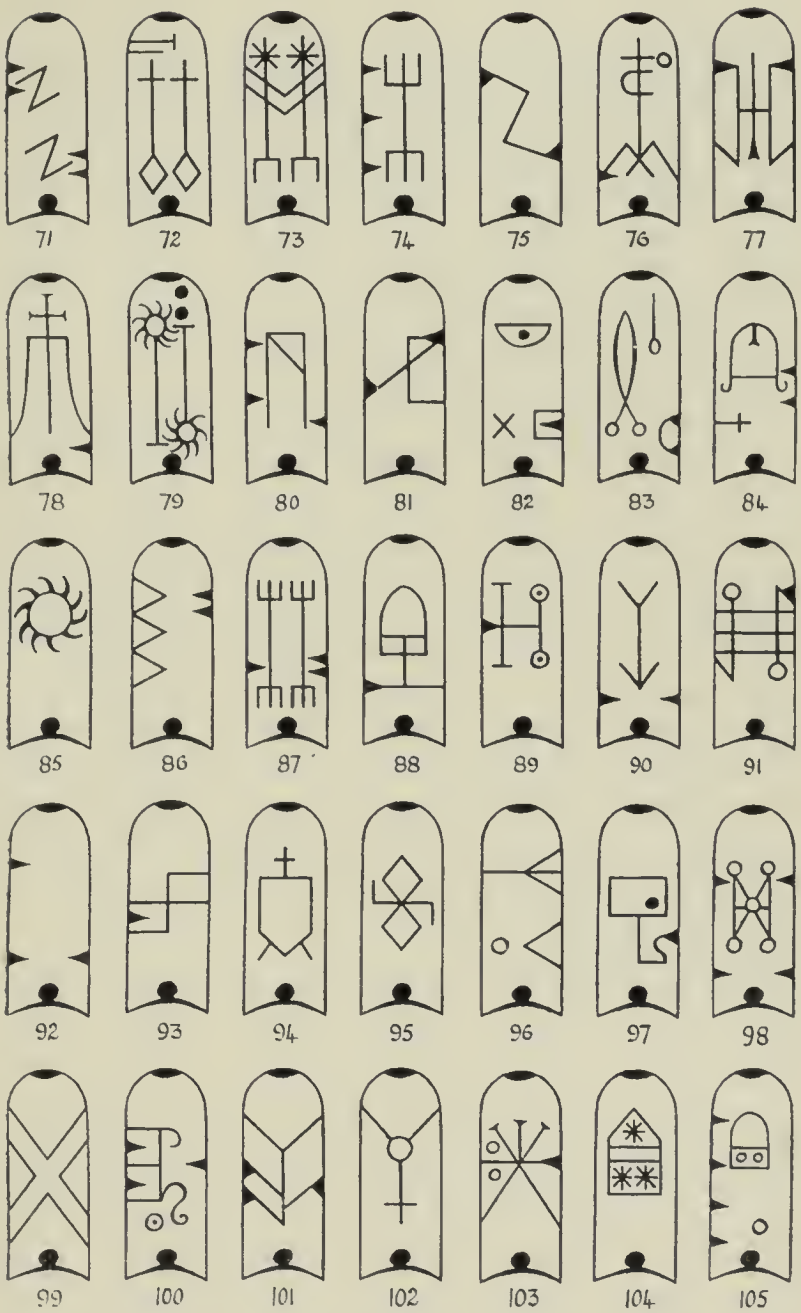
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FIGURE 3

one was disposed of, either by him or his son Henry, to Sir Thomas Golding of Belchamp St. Pauls, Essex, who was alive in 1571. His father, Thomas Golding, had bought Dunham Magna in 1547.

96. Robert Everard, *idem*.—After his death this mark passed to his son and heir Henry, and then to Adam Harte of Walpole (d. 1573), who had married Henry's sister Maud. Then for a time it appears to have been owned by one of the Lincolnshire family of Irby and finally to have returned to Norfolk ownership in the person of William Gurlinge of King's Lynn, who was Mayor of Lynn in 1593 and 1600.

97, 98. Robert Everard, *idem*.—These two marks are only recorded for him and his son Henry. No. 98 was known by the name of "the v Blotts," the reference evidently being to the five annulets (*cf.* "the iiij Blotts," No. 180).

99. Robert Everard, *idem*.—This mark, known as "the iiij Dawds," does not appear to have remained in the Everard family after Robert. It was next owned by John Wright, perhaps of Walpole, and then by Edmund Thompson of Sutton St. Mary, Lincolnshire. From him it went to Robert Leman of Walpole and then to Thomas Coney of Sutton St. Mary, who had married his daughter and heir Dorothy. Thomas died in 1616 and was succeeded by his son, William Coney of Walpole and Sutton, who was born in 1609. From him it went to his son and heir Robert Coney of Walpole, who was born in 1633 and died in 1707.

Edmund Thompson "differenced" the mark by adding a small annulet in the centre of the saltire and by assuming a lower mandible mark, thus described in the Swan-master's certificate:—"this mark allowed wth a tick att the bills end on the farr side on the nether chappe." Thomas Coney "differenced" by adding a second, "2 ticks in ye mouth," and William a third, "3 ticks on the mouth." Robert "differenced" by omitting all these, but retained the annulet.

100, 101. Henry Everard, of Walpole.—No. 100 is not recorded for any other owner, though it occurs in several rolls under the surname only. No. 101 passed from him, out of Norfolk ownership, to the Pulvertofts of Whaplode in Lincolnshire. On this family coming to an end in 1604, it was acquired by the Oxboroughs of King's Lynn and was used by

William Oxborough in 1622. Sir William Dramy, whom I have not been able to find was the next owner and he was succeeded by Benjamin Holly of Lynn, who was Mayor in 1657 and 1665.

102. Richard Everard, of Fittons manor, Wiggenhall St. Germans, who died in 1566. The ownership of the mark followed the ownership of the manor, Richard being succeeded by John, who died without issue in 1573 and was succeeded by Henry Everard of Linstead, Suffolk.

Earlier owners whom I have not identified were Zacharias Adam and Smartfoot. As originally used by Adam the mark included a gap on the right edge of the bill in the basal third. Smartfoot "differenced" by moving the gap to the opposite side, Richard and Henry Everard omitted it altogether, while John restored it to the original place.

103. Everard.—There is no clue as to the identity of this owner, but it seems probable that it belonged to some branch of the Norfolk family, as it was afterwards owned by the Gurlinges, either of Outwell or of Lynn, but again no christian name is recorded.

104. Everard.—There is again no clue to this owner, which is a pity as the mark was evidently derived from the family coat of arms. That of the Norfolk branch, to which the mark without much doubt belonged was :—"Gules, on a fesse between three estoiles argent, a mullet sable." It was "differenced" by successive members of the family, first with a gap on the right side opposite the middle of the shield and later with three gaps at the left base and an annulet at the right base. It was subsequently (presumably) sold to the Gawsells of Watlington and was so altered by them, that were not the intermediate steps recorded on different rolls, the ultimate result could never be connected with the original. As first altered the fesse became a single line and the stars roundels, the gaps and annulet being retained.

105. Edmond Gawsell, second son of Thomas Gawsell of Watlington, alive in 1600. There is no clue as to which Gawsell purchased this mark from the Everards, but the final stage in its evolution is shown in this drawing.

These last two marks illustrate the importance, to which I have already drawn attention, of comparing a number of

different rolls together. Without having done so it would have been impossible to deduce that Edmond Gawsell's mark had its origin in the coat of arms of the Everards.

106. John Faulkes, of Mundford.—A later member of the family (christian name unrecorded) " differenced " by adding two gaps on the left edge at the ends of the outer limbs of the W and one on the right edge in the centre of the distal W.

107. Edmond Fincham, of Rougham, will dated 1471. The mark is not given for any later owner.

108. John Fincham, of Outwell, died 1527.—This mark descended in the elder branch of this family through John's eldest son Thomas (who is not recorded on the rolls) to the latter's son Richard, who died without issue in 1602. It then passed to his nephew and heir Edward, son of his brother Robert, who was born in 1566 and died in 1631. Richard " differenced " it by omitting the basal gap, which was restored again by Edward.

109. Simon Fincham, of Outwell, d. 1538, the founder of the younger branch of the family. It probably descended to his son Simon (d. 1615) and was sold by him to a member of the Warner family, but no christian name is given. It had previously been owned by Robert Sumpter, whom I have not identified.

110. Simon Fincham, *idem*.—This mark descended to Simon the younger (d. 1615) and to his son and heir John. At the latter's death in 1621 it passed to his younger brother Balam, who was baptized in 1569. Subsequently it was owned by Phillip Bell of Wallington, who was alive in 1707, and had presumably bought it from a later John Fincham, who sold the Outwell estates about 1709.

111. Simon Fincham, *idem*.

112. Folsham, of Outwell.—This is nowhere given with a christian name, but it passed from that family to Thomas Gurlinge of Outwell, by his marriage with Ellen Folsham. He " differenced " the mark by inverting it.

113. Sir Richard Fulmerstone, of Stow Bedon, Thetford and Halwick, knighted 1560, died 1566. This is the mark (" differenced ") that he acquired with the property of the dissolved Canons of St. Sepulchre of Thetford. After his death it passed to his daughter and heir Frances and her husband Sir Edward Clere of Blickling (*cf.* Nos. 10 and 72).

Martin (*t.c.*) prints the Inquisition Post-mortem of Sir Richard, in which the following passage refers to this swan-mark:— "*Dominium et manerium de Thetford tenetur de R^a in soccagio ut de duc. Lanc. scil' nuper cannonicor' ib'm cum libertatibus lib'e warrenne faldagiis, etc., in Thetford . . . . ac piscar' et libertat' habere cignos in rivolis et aquis de Thetford . . . .*" and Sir Edward Clere and Frances made, amongst others, the following claims "House and scite of the Church of St. Sepulchre, with sac, soc" . . . etc., etc. . . ." Free warrens, fisheries, swanneries; all the commons, turbaries, breweries, late belonging to the Canons."

114. THOMAS GARDENER, of Cokesford.—This mark was originally the property of the church of St. Wendreda, March, in Cambridgeshire and was obtained, at the dissolution by Hugh Gardener of March and descended to this Thomas, his son. It afterwards went to the latter's son Humphrey, who was of Histon, Cambs. and alive in 1619. The semi-circular gap was Hugh's "difference" mark.

115. THOMAS GARDENER, *idem*.—This mark also came to Thomas from his father. After him it went to Francis, either his younger brother or his grandson, the second son of Humphrey, who differened it by adding a lower mandible mark "3 tycks within ye mouth,' one in the middle on the left, and one near the base and one near the tip on the right.

116, 117. JOHN GAWSELL, of Wallington and Watlington, *viv.* 1504.—Both marks are frequently recorded under the surname only and John is the only member of the family definitely named. It is clear, however, that they descended to the next two generations, Thomas who sold Wallington in 1525 and Richard, who died in 1538, for No. 116 is found "differenced" with a lower mandible mark "w^th a tyke one ye mouth" and both passed into the possession of William Buttes of Shouldham Thorpe (alive in 1563, died before 1569) who married Ursula (Walcott) the widow of Richard Gawsell. They both then probably descended in the Buttes family, but this is impossible to prove as the two succeeding generations were also named William, the second dying without issue in 1624. In four rolls (which are virtually copies of one another) this later owner is called *Sir* William Buttes. There seems to be no record that any William Buttes of Shouldham was

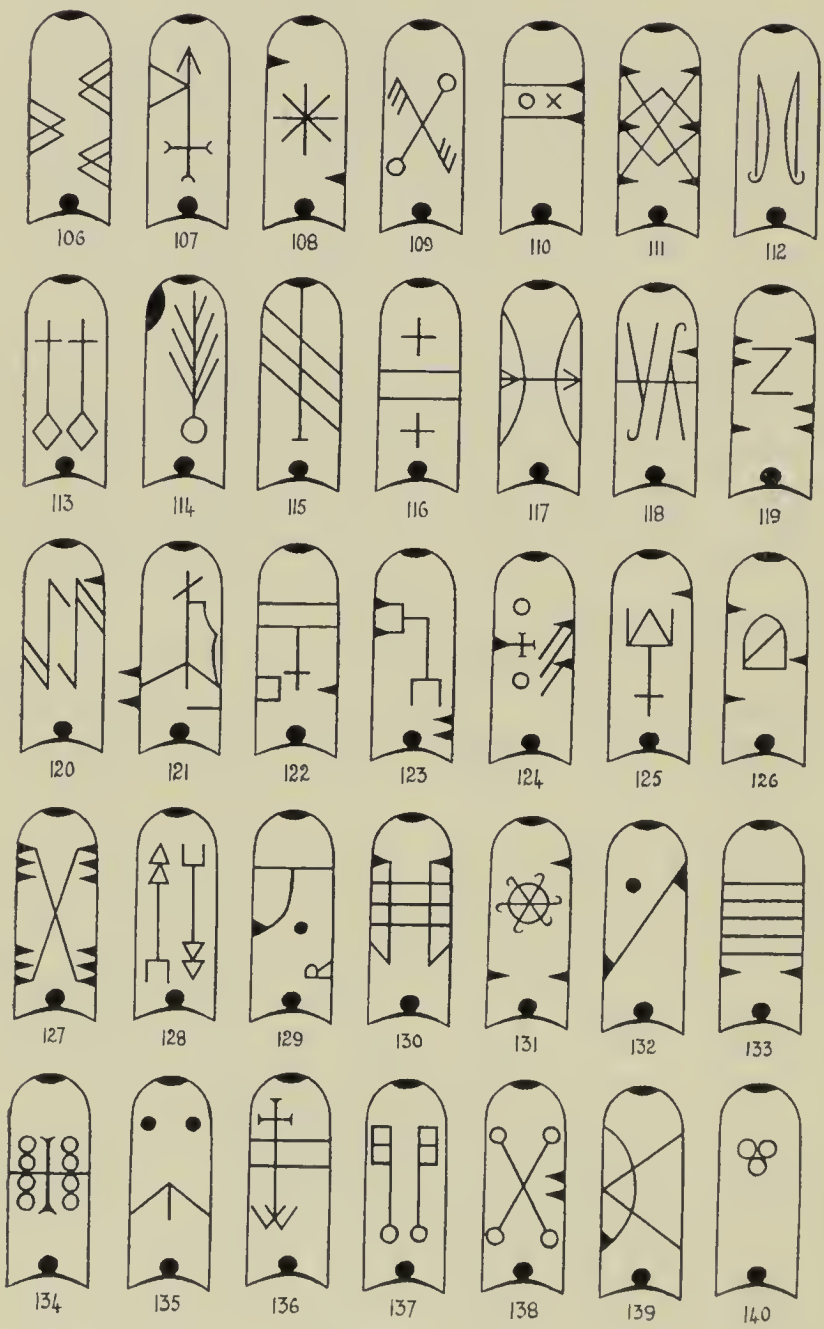
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FIGURE 4

knighted, so if this title is correct one would have to identify this owner with Buttes of Thornage, either the elder who died in 1545, or the younger who died in 1583. I believe, however, that these entries are erroneous and that the direct descent traced above is the correct one. Three exactly similar errors are to be found in each of these same four rolls.

118. Thomas Gurlinge, merchant of King's Lynn, Mayor in 1621, 1634 and 1642, died 1644. This mark was called "ye Dobill esis."

119. Richard Godbold, of Fincham, alive in 1612.

120. Thomas Graves, of King's Lynn and Pinkneys manor, Tatterset, Mayor of Lynn 1567, 1574 and 1584, M.P. 1571, dead before 1594.

121. John Grendell, of King's Lynn, Alderman 1506, alive in 1515. John Grendell junior was Alderman in 1524.

122. Edmund Grymston of Oxborough, died 1570.—The mark was afterwards owned by one of the Hobart family, but no christian name is given.

123, 124. Anthony Guybon, alive in 1566, was the second son of Thomas Guybon of King's Lynn, but I can find nothing more about him.

125. Thomas Guybon, of King's Lynn, Mayor in 1503 and 1509, Sheriff of Norfolk 1513 and still alive in 1528. His son Thomas, who was living in 1562, "differenced" the mark by omitting the gap.

126. Thomas Guybon, of King's Lynn, the younger.—This mark, which is apparently derived from the family arms :— "Or, a lion rampant sable, over all on a bend gules, three escallops argent," was used by Thomas senior with the right-hand gap only and was "differenced" as here drawn, by his son. It afterwards descended to the latter's son Humphrey of Lynn and Stradsett, high sheriff in 1596 and still alive in 1599 and was further "differenced" by a still later member of the family (unspecified) by moving the right-hand gap to the base and adding two more beside it.

127. William Guybon, of Watlington, *viv.* 1590, the half-brother of Humphrey (*supra*). This mark is nowhere recorded with any christian name, but it occurs on two rolls for Skipwith, which makes it fairly certain that it must have belonged to this William Guybon and then to Edmund Skipwith of Snowre

Hall in Fordham (*viv.* 1620) who married his daughter Elizabeth (or Anne). The latter " differenced " the mark by drawing the ends of the saltire right to the edges of the bill and so enclosing within them all the gaps on each side, except the proximal pair, which were left free at the base of the bill.

An earlier owner was Barmeson, or Bermyston, whom I have not identified, unless it be the Suffolk family of Barnardiston.

128. John Harte, of Walpole.—Afterwards the property of his son Adam, of Walpole, who died in 1573. In the seventeenth century it was used by Henry Reppes of West Walton (d. 1628), who " differenced " it by adding a lower mandible mark " 3 ticks in ye neere side."

129. Adam Harte, of Walpole, d. 1573.—This mark, known later by the name of " the Hammer head and Roman R," has a long history. The earliest owner was one Perse, or Parres, unidentified unless he be John Peyrse of Northwold, which is possible. Adam Harte then held it and both these earlier owners used it without the " Roman R," which was a " difference " mark added by Robert Knight the next in order, whom I have failed to find. From him it passed to Audley Baker *alias* Ladde, of the Bishop of Ely's manor, Terrington St. Clement, who used it in 1622. Robert Baker *alias* Ladde, his son, sold it in 1646 to Anthony Williamson of Kenwick in Tilney. The deed of sale will be found printed in full in *Eastern Counties Collectanea*, vol. I. (1872–3) p. 77.

130. James Hawe, Steward of the Duchy Manor of Woodhall, Hilgay, bought Modneye Hall, Hilgay, in 1545, died 1552-3. The mark descended to his son Henry, who died in 1592 and then to Sir John Willoughby of Risley, co. Derby, who had married his daughter and heir Frances. Henry also became an owner of Swans in Broadland and used the same mark for them, but " differenced " it by making the gaps semi-circular, instead of triangular (*cf.* mark No. 144, vol. XII., p. 453).

131, 132. Arthur Hewar, of Oxborough.—I can find but little about this man except that he was the younger brother of Thomas Hewar of Oxborough Hall in Emneth, must have been living quite early in the sixteenth century, up to about

1540, and apparently died without issue. Both these marks then became the property of the Bedingfields of Oxborough, first of Sir Edmund, who died in 1553, then of Sir Henry (d. 1583), Edmund (d. 1585) and Thomas (d. 1590). From the last named they passed to Henry Jerningham of Costessey, on his marriage with Thomas's widow, Frances, daughter of John Jernegan of Somerleyton. Henry died in 1619.

133. Arthur Hewar, *idem*.—This mark passed to Thomas Hewar, either his elder brother, or the latter's son, who died in 1585, aged 66. It afterwards belonged to the latter's son Sir Thomas (No. 135).

134. Thomas Hewar, of Oxborough Hall, Emneth.—It is not possible to be sure how far back this mark goes as there were at least four successive generations of Thomas Hewars. I think, however, there can be little doubt that it goes back at least to Thomas (the elder brother of Arthur, No. 131) who was alive about 1518. On the other hand it cannot have been used for very long by Thomas his son, for he must have disposed of it quite soon to the next owner, Edmund Peyrse of Oxborough, the second son of John Peyrse of Northwold, who " differenced " it by adding two gaps at the left base and by increasing the number of annulets. The latter seem to have been varied in number from time to time by each owner.

135. Sir Thomas Hewar, who succeeded his father at Emneth in 1585, was Sheriff of Norfolk in 1613 and died without issue in 1630. This mark occurs only as an additional entry at the end of an early seventeenth century roll and so was probably not granted till about 1620.

136 Sir Christopher Heydon, of Baconsthorpe, knighted about 1550, died 1579. This mark was afterwards used by a Mr. Fenne, whether of Wiggenhall or Lynn is uncertain, and was " differenced " by him by the addition of a gap on the right edge between the bars.

137. Sir James Hobart, of Hales Hall, Loddon, knighted 1503, died 1517. It was afterwards used by a Mr. Rudhall, whom I cannot identify.

138. Sir James Hobart, *idem*.—This mark afterwards passed through the hands of the same Mr. Rudhall, John and C. Harte, Mr. Ashon and Nicholas Halge, none of whom I

have been able to identify, and was finally owned by Thomas Howson and his son Sir William, both of Wigtoft in Lincolnshire.

139. HOLLYER.—In most rolls the surname only is given, though in one the initial "A" appears before it. I have little doubt that the mark belonged to the Lynn family of Hollyer of whom John was one of the Common Council in 1523, and Robert, Mayor four times between 1564 and 1585. A. Hollyer I take to be an even earlier member of the family. The mark was afterwards owned by Thomas Might (*vide* No. 171).

140. ROBERT HOUGHTON, of Bereford Manor, Anmer, to which he succeeded in 1544, Town Clerk of Lynn 1557-8, dead before 1570.

141. HENRY HUNSTON, of Walsoken, *viv.* 1582.—An earlier owner was John Hyppe, whom I believe to have been of Sutton St. James in Lincolnshire. A later owner was Mr. Adamson, who was possibly a Marshland man. The Hunston family appears to have been a large one of several branches in Marshland and Holland and they were undoubtedly large swan-owners. Unfortunately no very satisfactory pedigree of them is available, so that the identification of individual members must be somewhat tentative and the succession in their different marks difficult to establish.

142. RICHARD HUNSTON, of Walpole, d. 1547.—He was succeeded in the ownership of this mark by his son Henry (No. 141), who "differenced" it by adding a gap at the left base.

143. HENRY HUNSTON, of Walpole, *viv. temp.* Henry VIII. This mark was known by the name of "the Clickett keys," and was owned by three (or four) members of this family, Henry, William and Thomas. The Henry is certainly an earlier man than Henry of Walsoken (No. 141), so I take it he must have been Henry of Walpole, who married Jane, the daughter of Sir John Audley of Swaffham. William I take to be William of Walpole, who died in 1567 and elder brother of Henry (No. 141), but what his relationship to the original Henry was is not clear. He was presumably succeeded by his eldest son William of Walpole and Boston, who was Sheriff of Lincolnshire in 1572 and died in 1582, when the mark went to his eldest son, Thomas of Walpole. One or other of the Williams "differenced" it with a gap on the right edge,

cutting into the annulet. It subsequently belonged to William Atkin of King's Lynn, who was Mayor in 1619 (*vide* No. 23) and in 1626 to Elizabeth Cooke of King's Lynn, who sold it in that year to John Wallis, merchant and Alderman of Lynn.

The original deed of sale is preserved in the British Museum (Add. Ch. 16, 550) and as these documents are extraordinarily rare, and this one has never before been printed, it may be of interest to give it in full. It is a vellum deed 7⅛ by 13 inches and contains a drawing of the mark down the left margin.

> " Be it knowne to all men by theise presents that I Elizabeth Cooke of Kyngs Lynne in the County of Norff. widowe for dyvers, good and reasonable causes and considerac'ons me movinge Have bargayned sold given, and granted and by theise presents doe bargayne, sell, give, and grant vnto John Wallis of Kyngs Lynne aforesaid Merchant one of the Aldermen there All that Swanmarke comonly called or knowne by the name of the Clickett Keys wth one Gappe under the feathers, marked formed or fashioned, as in the Margent hereof appeareth Togethe[r] wth All Swannes Staggs and Signetts of the same marke or wth the same marked, or thereunto in any wise belonginge or apperteyninge To have and to hold thesaid Swanmarke, and all and singular the Swannes Staggs and Signetts aforesaid to the said John Wallis his executors administrators and assigneys as his and their owne proper goods forever. In witness whereof I the said Elizabeth Cooke have herevnto sett my seale the Sixt daye of November in the Second Yere of the Reigne of our souerigne Lord Charles by the grace of God Kynge of England Scotland ffrance and Ireland defendor of the faith, etc. 1626."
>
> [Signed] " Elizabeth Cooke."
> [Witnesses " Nathaniel Mapen."
> " John Lecett."
>
> Tag for seal, wax gone.

144, 145. Henry Hunston, *idem*.—No. 144 was known by the name of " ye Hamar hedde." Both followed the same succession in the Hunston family as No. 143.

146. Henry Hunston, *idem*.—This mark went to Clement Hunston of Ruskington, in Lincolnshire (another brother of Henry No. 141), who died without issue in 1582. He was succeeded by John Hunston and by William Hunston of Tydd, neither of whom I have been able to fit into the pedigree.

147. John Jenney, of Great Cressingham, d. 1575. The mark passed by the marriage of his widow, Elizabeth, daughter of Robert Spring of Lavenham, to her second husband Edward Fludd, who was Gentlemen Usher to Queen Elizabeth and leased Shropham Hundred from the Crown 1573 to 1584 and died in 1588.

148. Edmund Jermyn, of Sturston, died before 1606.

149. Humphrey Jordan, of Congham; his Inq: P.M. dated 1561.

150. Humphrey Kervyle, of Wiggenhall St. Mary, d. 1540. Afterwards owned by his third son Edmund, and the latter's nephew Henry of Wiggenhall.

151. Humphrey Kervyle, of Watlington, son of Humphrey Kervyle of Lynn, who was alive in 1535. The mark is derived from the family arms :—"Gules, a chevron or, between three leopards faces argent."

152. Knevett.—This mark is nowhere recorded with a christian name, but fortunately we find it on one roll under the name Springe, which makes it certain that it belonged to the Buckenham Castle family. Though it is not possible to say how far back the ownership extended, it must have belonged to Sir Thomas Knevett, who died in 1594, leaving his son Phillip a minor of eleven. His widow Lady Catherine, daughter of Sir Thomas Lovell of East Harling, re-married Edward Springe, a grandson of Robert Springe of Lavenham, Suffolk, and died in 1610.

153. Lady Knevett.—This mark is also mostly given with the surname only, though on five rolls it occurs with the present title. The lady intended might have been the wife of one of the Knevetts of Buckenham Castle, but female owners (as apart from their husbands) are uncommon, so that on the whole I feel fairly confident in identifying her as Jane, the daughter and heir of John, 2nd Baron Berners, who died in 1532. She was *de jure* Baroness Berners, owned several manors in Walpole and many in the Holland division of Lincolnshire and married Edmund Knevett of Ashwellthorpe. She died in 1561 and was succeeded by her grandson Sir Thomas.

154, 155. H. Lambert, of Well (*i.e.*, Outwell, or Upwell). I can find nothing about this owner, or his family. The mark as originally recorded without any gap dates from the time of Henry VIII., and these two are evidently later variants of it. It afterwards belonged to one of the Walpoles, presumably of Houghton.

156. John Lavarocke, of Outwell.—Later owners were Richard Howlett, who was perhaps one of the Howletts of

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FIGURE 5

King's Lynn, but I have not been able to find him, and John Byrde of Hilgay, who was alive in 1601.

157. Lawrence Lavarocke, of Outwell.—This mark, known as the " yelt staffe and ij bars," was owned successively by Lawrence and John Lavarocke, of whom I can learn nothing except that they belonged to Outwell. It then passed to John Drewry of Swaffham, Cambs., through his marriage with Elianor, the daughter of John Lavarocke, and was " differenced " by him by the addition of the leg-mark as drawn in No. 158. It subsequently became the property of one of the Bishops of Ely, but which it is impossible to say. He used it without the leg-mark, but " differenced " it by reversal.

158. John Drewry, of Swaffham, Cambs.

159. William Lexham, of Lexhams manor, Burnham Westgate, d. 1500.

160. Sir Thomas Lovell, of East Harling and Barton Bendish, knighted 1553, d. 1567. The mark descended to his son, Sir Thomas, who died in 1604 and his grandson Sir Francis, who was knighted in 1603 and died in 1623, without issue. One of the Sir Thomas's used the mark with only one gap, while Sir Francis " differenced " it by moving one of them to the left side of the bill opposite to the remaining one. Another member of the family (unspecified) used it with two gaps on the right and one on the left. Three rolls give the mark as here drawn for " Sir J." and " Sir John " Lovell and two for " Sir E." and " Sir Edward " Lovell. I cannot find that there was ever a Sir John or a Sir Edward in this family and suspect that mistakes have been made in copying from older rolls.

161. Lawrence Male.—I can find nothing about this man except that he died before 1527. I suspect, however, that though he may have belonged to Norfolk, both he and Robert Hill, the next owner of the mark, belonged to Sutton St. James in Lincolnshire. From the latter, however, it came into Norfolk ownership, being acquired by the Anguish family of Great Melton. It was afterwards used by one of them in Broadland waters, but differenced by reversal, as already recorded (Vol. XII., p. 459, No. 178).

162. Nicholas Megges.—I have not succeeded in fixing this man with certainty. He was alive in 1547 and was

I imagine the brother of Thomas Megges (No. 163) and a native either of Wisbech or of some adjacent place in Norfolk. From him the mark passed through the hands of the Wisbech families Lind and Crosse and thence by the marriage of Ann, the daughter of Thomas Crosse, some time before 1592, to her husband Robert Poulter of Broughton in Huntingdonshire. He, however, disposed of it before many years, presumably by sale, to Sir Thomas Hunt, a soap-boiler of London and a member of the Fishmongers' Company, who had bought Byntre Hastings Manor in Brandeston, Hackford, Guton, Folsham and the Hundred of Eynford in 1582. He was knighted in 1603 and died in 1616.

163. Thomas Megges, of Upwell, was granted Thurning Manor, Upwell, in 1539, was Constable of Wisbech Castle in 1531 and Chief Bailiff of the Isle of Ely in 1546. After him the mark, which was known as "the latheres" (ladders), was used by John de la Hay of Terrington and then by Thomas Harvey of West Walton, who was alive in 1564. From him it went to Thomas Gray of Wisbech, who, dying in 1593-4, devised it to his nephew Henry Gray. Soon afterwards it was acquired by Francis Parlett of Wiggenhall, who died in 1605 (*vide* No. 186).

164. Thomas Megges, *idem*.—After him the mark belonged to William Humberstone of Mildenhall, who was M.P. for Thetford and died between 1572 and 1583. It then passed to the Edens of Thetford and was used by Edward, who was Mayor in 1584 and Town Clerk in 1601 and by George, who was Mayor in 1622. William Humberstone "differenced" it by reversing the position of the gaps and Edward Eden by sloping the main design in the opposite direction. George Eden reverted to the original mark.

165. Megges.—There is no evidence as to who this owner was, though presumably he was either Nicholas, or Thomas, or related to them. After him the mark belonged to Lawrence Johnson, whom I have been unable to find and then passed to the Balams of Walsoken and was used by Charles who died in 1592 and Robert, but the pedigrees available are so imperfect that it is not possible to follow the exact succession. The latest, however, would appear to have been Robert, for in 1609 it belonged to Sir Richard Coxe of Brame near Ely, who

married Mary, the daughter of Sir Robert Peyton of Isleham, and widow of Robert Balam. There can be little doubt but that it was in this way that he obtained possession. After him it came back into Norfolk ownership in the person of John Fincham, junior, of Outwell, who succeeded his father John in 1621 and died in 1649. Sir Richard Coxe "differenced" the mark by transferring the gapped cross to the other side of the bill.

166. MEGGES.—Here again there is no clue to the owner's identity, nor whether he was actually the earliest, for the mark is given also for Damett another Upwell family (*vide* No. 79) that may well have owned it before Megges. It then belonged to the Sapcottes, but whether the Huntingdonshire family or not I cannot say, but I think it improbable. Two later owners are given, E. Smyth, whom I cannot identify and Robert Fincham of Outwell, who was alive in 1579. I think it very likely that all these owners were natives of the Upwell-Outwell district.

Though of an heraldic appearance I cannot find any heraldic derivation of the mark, but I can find no arms recorded for either Megges or Damett, if they were entitled to any. The Dametts and Sapcottes made the mark with the point of the shield towards the base of the bill as in No. 167. E. Smyth used it as here drawn, but added a gap at the right tip, while Robert Fincham's modification is shown in No. 167.

167. ROBERT FINCHAM, of Outwell, *viv.* 1579.—This mark is Megges No. 166 reversed and further "differenced" by the addition of a gap at the left base and two ticks in the lower mandible on the left side.

168. WILLIAM METHOLD, of Langford and South Pickenham, whose will was proved in 1539; or possibly his second son, William of Rusworth.

169. METHOLD.—Though given on nearly every roll, no christian name occurs, but I have little doubt that this was the mark used by the later Metholds of Langford and South Pickenham, namely John, who died in 1552 and Thomas, who died in 1632. It is obviously taken from the initial letter of the family name. In the middle of the seventeenth century it belonged to Sir Thomas Grant, whom I have failed to find.

170. ROBERT MILLER, of King's Lynn, *viv.* 1558. He was granted the Abbot of Ramsay's manor, Wimbotsham, in 1545.

171. Thomas Might, appears to have been a Norfolk man, though I cannot locate him with certainty. He was married at Feltwell in 1582 to Elizabeth the daughter of Osbert Mondeford, was patron of Dunham in 1591 and was still alive in 1601.

An earlier owner of the mark was William Brown, possibly the wealthy merchant of Stamford, who died in 1489, but this is uncertain. Thomas Might was succeeded by Anthony, the fifth son of Richard Buckworth of Wisbech. As originally used by William Brown and later by Anthony Buckworth the mark was made with the arrow heads towards the base of the bill.

172. Adam Mondeford, of Feltwell, d. 1463.—The mark descended through his son and heir Osbert (d. 1490) to his son and heir Francis (died about 1538) who was succeeded by his second son Francis, the founder of the Wereham branch of the family. To this branch the mark was thereafter attached, but in the absence of christian names on the rolls it is uncertain how many generations used it. It was " differenced " by this branch by removing the basal pair of gaps to the right side opposite to the distal pair.

173. Osbert Mondeford, of Feltwell, d. 1580.—The mark may possibly have belonged to his grandfather Osbert (d. 1490), but there is no means of telling. After his death it went to his son Edmund, who was knighted in 1603 and died before 1617, and then to his grandson Sir Edmund, who died without issue in 1643. It then became the property of John Cockayne, who was presumably a Bedfordshire man and in 1656 it belonged to John Cutts of Childerley in Cambridgeshire.

174. Osbert Mondeford, *idem*.—After his death it went to his sixth son Richard, about whom I can find nothing, except that he left no issue.

175. Mondeford.—There is no clue as to who owned this mark as no christian name is given. It is also found without the right-hand gap.

176, 177. Martin Mondeford, of Wereham.—Both marks are to be found on several rolls under the surname only, and No. 176 with the left-hand gap only, so that they may have belonged to his father Francis (*vide* No. 172).

178, 179. Richard Nicholls, of Tilney, was granted West Dereham Abbey Manor, Tilney, in 1559, alive in 1562, but died

without issue. After his death both marks were acquired by the Prentis family of Wiggenhall St. Mary Magdalen and were used in succession by Thomas and his son John and then by William and "E.," neither of whom are to be found in the printed pedigree. No. 178 was "differenced" by them by moving the device to the base of the bill.

180. William Norman, of Outwell.—The mark, known as "the iiij Blotts" (*cf.* No. 98) was afterwards owned by Robert Caster and Edmund Fakins, neither of whom can I find The latter "differenced" it by adding an inverted V on the left basal quarter of the bill.

181. Sir Henry Ogard, of Hackbeach Hall, Emneth, d. 1511. After his death it passed to his son and heir Andrew (d. 1526), who "differenced" it by omitting the two basal gaps on the right. It then went to Andrew's second son Henry, who appears to have died without issue. Though not actually recorded for him, it must have then passed to his younger brother William, who owned Hackbeach Hall. His widow Winifred, daughter of John Reppes of West Walton, married secondly Thomas Hewar of Oxborough Hall, Emneth (d. 1585), who thus acquired both Hackbeach Hall and the mark. He "differenced" by restoring the basal gaps and moving the annulet to between the proximal bar and the diagonal. The mark was later owned by William Atkin of Lynn (*vide* No. 23).

182. Sir Henry Ogard, *idem.*—The succession of this mark was the same as No. 181, except that it is recorded for George, Andrew's eldest son (who like Henry seems to have died without issue) and so was held by the three brothers in succession, ultimately going to Thomas Hewar. After the latter's death in 1585 it went to his son and heir Sir Thomas, who died without issue in 1630. Lawrence Oxborough, the second son of Thomas Oxborough of King's Lynn, and grandson of his sister Thomasin was his heir and inherited both Hackbeach Hall and the mark.

183. Andrew Ogard, of Walsoken, *viv.* 1646, the third son of Andrew of Walsoken (*viv.* 1561) and grandson of William of Hackbeach Hall (*vide* No. 181).

184. David Orrell, of Overhall in Boughton and Wereham Hall, who was married in 1449. In one roll the mark is given for Mistress Orrell, so that it is to be presumed that his wife,

Elizabeth, daughter and heir of Alexander Marshall of Overhall in Boughton, outlived him. It is also recorded on one roll for his son Sir Lewis. From him it seems to have passed to the Cressener family, presumably of Morley, though I can find but little about them, and no christian names are given on the rolls. After them it was held by a succession of Wisbech families, Crosse, Freeman and Swaine, the last of whom, Robert Swaine, was alive in 1643.

185. John Palgrave, of Palgrave, d. 1467.—No other christian name is given with this, but in several rolls he is called *Sir* John. I cannot, however, find any titled member of this family until 1641, which is much too late for the entries on the rolls. Apart from this there is a difficulty in identifying this owner with certainty. Besides the one given above, whom I fix as the most likely, there were John (2) his grandson and John (3) his great grandson as possible owners. John (2) was the son of Henry, who died in 1513-14, and himself died before 1524 and probably a minor, so that he cannot have been an owner for more than a year or two, if at all. John (3) was a nephew of John (2) and died in 1611, aged 80. He was of Barningham Norwood, a long way from the Fenland, and therefore he is not very likely to have been the originator of a Fenland mark. Moreover he would have had to have been an owner at about the age of twenty-four to have got his name on to one of the rolls on which the mark is entered, while his father Clement was still alive in 1581 and resident on the borders of the Fenland. I have no doubt, however, that the mark descended to, and was used by both of them, and that it is John (3) who is recorded in some of the rolls with the mark "differenced" by inversion. Despite the heraldic character of the mark it has no relationship to the Palgrave arms.

186. Francis Parlett, of Wiggenhall, Recorder of Lynn, d. 1605.—This mark was known as "ye trosses" and originally belonged to Thomas Gray of Wisbech, who died in 1593-4, but is not one of the three mentioned in his will (*vide* Nos. 54, 163 and 187). As used by him the foot-mark consisted of a slit in the *outer* webs of both feet, Parlett thus "differenced" by slitting the inner webs. After the latter's death it passed back to Wisbech ownership in the Edwards family, several of whom are given as owners on different rolls.

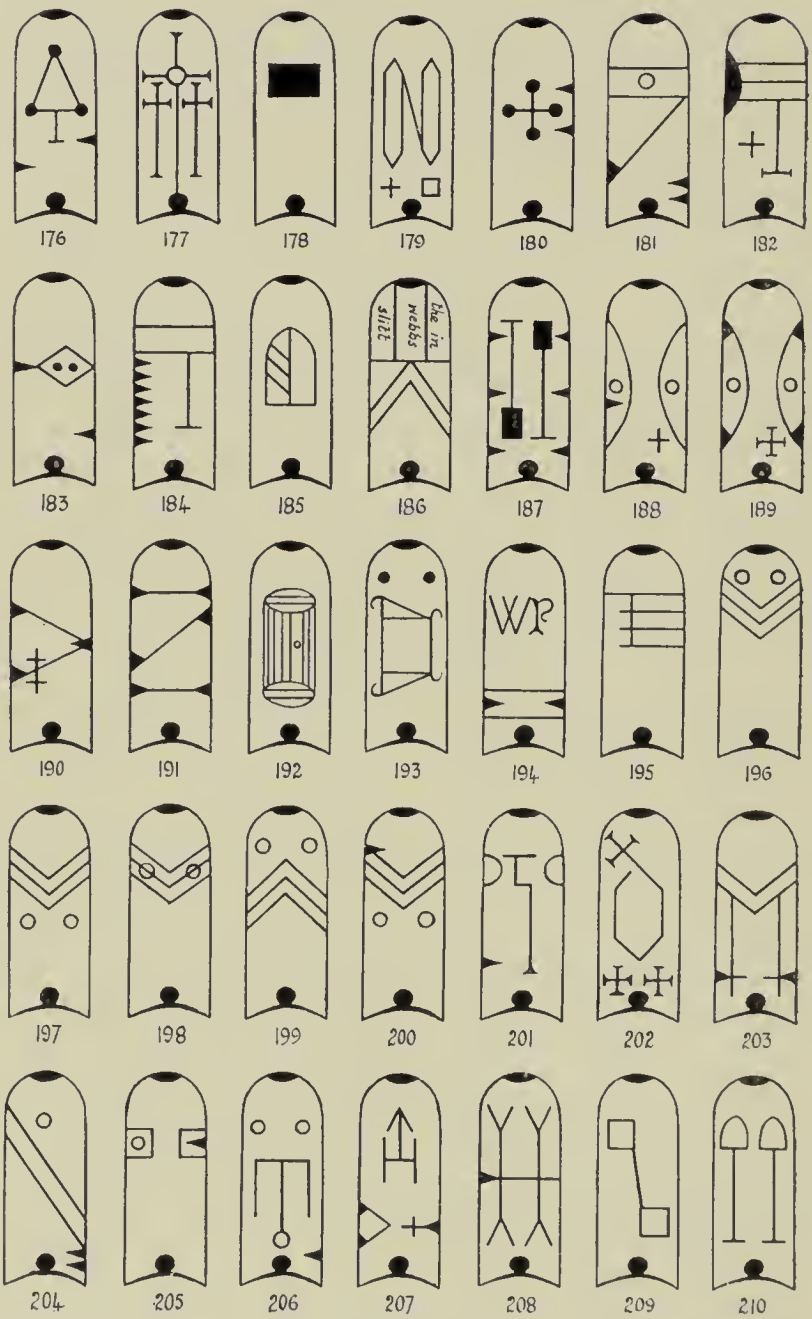
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FIGURE 6

187. William Parlett.—I imagine this owner to have been a brother of Francis (No. 186), though I can find nothing about him except that he was co-defendant with Francis in the Chancery action respecting one of Thomas Gray's marks (No. 54, *q.v.*) of which this was another. It was known as "the dobell pelles" (double peels) or as described in Gray's will "the Pelles with six gapes." It was devised by him in the same way as Nos. 54 and 163, but was evidently soon after acquired like the others by the Parletts. Like No. 186 it afterwards belonged to the Edwards family of Wisbech.

188. Edmond Peyrse, of Oxborough.—This mark known as "the Double Bowes" has quite a remarkably full pedigree covering nearly two centuries. The earliest owners, who must have been living quite early in the sixteenth century, were John and Richard Crofts. They used the mark without any annulets and belonged I believe to Swaffham, but their identification is not certain. The next owner was William Craye of Ely. From him it came back to Norfolk again in the person of Edmund, the second son of John Peyrse of Northwold, and was used by him as here drawn. From him it went to Mathie Walsingham of Reepham, who owned it in 1599 and "differenced" it by adding a second gap beside the first. His formal appointment of John Mann of Upwell to act as his deputy at the upping has been printed by me in *Brit. Birds* Mag. XXII., p. 81. The next owner was Edmund Bedingfield of Huntingfield in Suffolk, who used it without any gaps, and sold it in 1622 to James Tiffin of Emneth. In 1626 he (or another James) described as of Crimplesham, appointed John Deane of Emneth to act as his deputy for seven years. In 1641 James Tiffin, then described as of Rockland, who "differenced" the mark as drawn in No. 189, sold it to Thomas Reeve, clerk, Rector of Upwell. William Reeve of Upwell, presumably his son, sold it in 1666 to William Fenne of King's Lynn and from him, or one of his descendants, it passed by marriage to the Harwicks of Eaubrink and was owned by Fenn Harwick in 1712.

189. James Tiffin of Rockland, *viv.* 1641 (*vide* No. 188). The alienation deeds of this mark are the property of the Rev. H. S. Marriott of Wilby. The earliest of them transferring it from Edmund Bedingfield to James Tiffin is a parchment $6\frac{1}{4}$

inches by 12½ inches with fragments of a plain seal on a tag, and a drawing of the mark in the left margin :—

" To all true xpian people to whome this p'sent wryting shall come Edmond Beddingfeild of Huntingfeild in the County of Suff. gent. Sendeth greeting in our Lord God eu'lastinge Knowe ye that I the seid Edmond Beddingfeild for dyu'se good iuste causes and reasonable consideracons me herevnto movinge have gyven gr'unted b'gayned and sould and by these p'sents doe fully and absolutely gyve gr'unte b'gayne and sell vnto Jeames Tyffyn of Emneth in the County of Norff. yeoman As well all those my Swannes and Signetts whatsoeu' marked wth the marke made or conteyned in the Margeaunt of these p'sents comonly Called or knowne by the name of the Doble Bowes nowe being Swy'myng or remayninge in nigh or vpon any the waters Streames or Ryvers w hin the Isle of Elye in the Countye of Cambridge or else where wthin the Realme of England As also the seid Marke Called the doble Bowes And all my Estate right tytle Interest property and demaund of in and to all and eu'y the seid Swannes Signetts and the seid marke called the Doble bowes and eu'y of them To have and to Holde the seid Swannes Signetts and the said marke called the Doble Bowes estate right tytle prop'tye and demaund aforeseid to the seid Jeames Tyffyn his Execut' and assignes freelie and quietly for eu' as his and ther owne p'per goodes wthout any mann' of accompte money or other thinge therefore to be yelded payde or done vnto me the seid Edmond Beddingfeild my Execut' admyn' or assignes or to any of us In witness whereof I have herevnto sett my hand and Seale Gyven the three and twenty day of the moneth of July in the twenteth yere of the Reigne of our Sou'eigne Lord Jeames by the grace of god of England ffr'unce and Ireland Kinge defendo' of the ffayth and of Scotland the fiyve and ffifteth

p' me Edmunde Bedingfeld."

" Sealcd and delyu'ed
in the p'sence of
Jo. Pulham
Raffe Hurrell."

190, 191. Edward Pratt, of Hockwold, *viv.* 1550.—Both marks were afterwards used by Henry Pratt (*vide* No. 193).

192. Gregory Pratt, of Ryston, *viv.* 1573, the younger brother of Edward (No. 190). Also afterwards used by Henry (No. 193), who " differenced " it by adding three gaps at the right base and two at the left tip.

193. Henry Pratt.—I am unable to place this owner, though he undoubtedly belonged to the Hockwold-Ryston family. The only Henry given in the pedigree was the grandson of Gregory (No. 192) and settled in London. The present Henry must have belonged I think to a generation earlier. Before 1615 the mark passed to Thomas Dereham of West Dereham, who was knighted two years later and died in 1645. An earlier owner still was E. Clements whom I have not found.

194. William Prentis, of Wiggenhall St. Mary Magdalen, *viv.* 1523.—The mark was afterwards used by his second son Thomas, who "differenced" it by inversion.

195. John Reade, of Walpole.—He was the second son of John Reade of Weston Hall by Beccles, who was alive in 1561.

196. John Reppes, of Lovells Manor, West Walton, alive in 1540.

197. John Reppes.—There is no evidence as to who this John was. He may have been John of Wisbech, who died in 1561, the nephew of John (No. 196) and of Henry of Mendham.

198. Reppes of Tilney.—I can find no record of a Tilney branch of the family.

199. John Reppes, of Walpole and Emneth; alive in 1563 and 1577, but possibly father and son of the same name.

200. Henry Reppes, of Mendham, died without issue 1558.—This series of five marks is interesting from two points of view. In the first place they are true heraldic marks, being derived from the family arms:—"Ermine, three chevronels sable." In the second place they illustrate very clearly the system of "differencing" by separate branches of one family, who used a single mark for their swans, but by the "difference" marks were able to distinguish the birds belonging to one branch from those of any of the others.

201. Edmund Reray, Rector of South Runcton 1493, d. 1504.

202. Richard Saudell, of Saham Toney, d. 1557.

203. Robert Saye, of Tilney, d. 1633, *æt.* 60. There was an earlier owner, John White, whom I believe to have belonged to King's Lynn. There was a Lynn man of this name in 1523, but I am not satisfied that he was the owner. In some rolls it is given without the gaps, so that there were probably two or more earlier owners of the same name.

204. Sir John Shelton, of Deopham, knighted 1596.

205. John Shering, of Thetford, Mayor 1570, 1577 and 1592. It was afterwards owned by William Kaye and in 1614 by John Stanford, but I have not been able to identify either of them.

206. John Shouldham, of Marham and Shouldham, d. 1551.

207. Thomas Sidney, of Walsingham, granted Walsingham

Priory 1540, died 1544; and/or his son Thomas, who was Customer of Lynn and died in 1586.

208. Edward Skipwith, of Snowre Hall in Fordham, d. 1558. At or before his death it passed to John Hare of Stow Bardolph, who was alive in 1561, but died before 1577. A later member of the Hare family "differenced" it by adding a second gap, at the opposite end of the cross-bar.

209. Thomas Snelling, of King's Lynn. He died during his mayoralty in 1622. The mark is perhaps an adaptation of one of those of Spalding Priory.

210. Edward Some, probably of King's Lynn, where Robert Somes were living in 1512 and 1542-1609. The mark was afterwards owned by the Fennes, either of Lynn or of Wiggenhall.

211. Robert Southouse, of Downham Market.—The mark had had three previous owners, all of whom I believe to have belonged to Wisbech. The last of these was Thomas Peirson, who was Town Bailiff of Wisbech in 1641. The present owner married his daughter Lucretia in 1639.

212. Sir John Steward, of Swaffham, *viv.* 1436.—I have not seen this mark on any of the rolls for an earlier owner than Simeon Steward of Lakenheath, who was Sir John's great-great-grandson and alive in 1557. It answers however to the description of the mark (*baculus nodatus*) granted by Sir John to his son Thomas on the Vigil of St. Dunstan, 14 Henry IV. (May 18th, 1436), the grant of which is given in full in "*The Reports of Sir Edward Coke*," 1826, Vol. IV., p. 82 :—

"*Notum sit omnib' hominib' præsentib' et futuris, quod ego J. Steward, miles, dedi et concessi Tho' fil' meo primogenito et hæredib' suis, cigninot' meam armor' meor' prout in margine laterali pingitur, quæ mihi jure hæreditar' decendeb' post mort' J. Steward mil' patris mei : haben' sibi et hæredib' suis, una cum omnib' cignis et cignicul' cum dicta nota baculi nodati signat'*" . . . . etc. etc.

Sir Edward Coke adds "And in the margent was printed a little ragged staff."

It is to be noted that Sir John refers to the mark as derived from his coat of arms and that he had inherited it on the death of his father, so that its use extended back some time before 1436.

213. Nicholas Steward, of Outwell, alive in 1520. At his death the mark passed to his son Simeon Steward of Lakenheath, who "differenced" by inverting the central design. It was owned later by Sir Simon Steward of Stuntney, Isle of Ely.

214. Richard Sutton, of Feltwell, alive in 1599.

215. Sir Gilbert Talbot, of Peverels Manor, Great Melton, d. 1542. He was succeeded in the ownership of the mark by J. Allen, whom I cannot identify.

216. Samuel Terrand, appointed Rector of Mundford in 1662. The previous owner was Miles Forrest of Morborne, Hunts.

217. Thomas Thursby, of Haveless Hall, Mintling, and Gaywood, *viv.* 1572.

218, 219. Sir Thomas Tindall, of Poinings, Scales, Mundefords and Stewkeys Manors, Hockwold, knighted 1553, High Sheriff 1561, still alive in 1578. No. 218 afterwards belonged to his second son Sir John, of Much Maplestead, Essex, to Miles Tindall, whom I have not been able to find and then to one of the Paston family. No. 219 passed to a Mr. Felton.

220. Dr. Peter Tye, Rector of Southery 156—, of Wimbotsham 1574-5, of Watlington 1583-1592 and of St. Mary's, Barton Bendish 1592-4.

221. John Walpole, of Harpley.—The mark originally belonged to the Holtofte family of Whaplode, in Lincolnshire, and came to the Walpoles through the marriage of Henry of Harpley with Margaret, one of the Holfofte co-heirs. The first Walpole owner given on the rolls is Henry's eldest son, Thomas of Whaplode, who seems to have made the mark over to his younger brother John of Harpley.

222. Walpole, of Houghton.—The only owner definitely named is Sir John, who died in 1494. He used the mark without the distal gap. Later owners used it (A) as drawn here, (B) without the basal gap, (C) with two gaps close together at the middle of the right edge of the bill, and (D) with no gaps at all, but in no case is a christian name given.

223. Andrew Walsingham, of Upwell.—The mark, known by the name of "ye halfe mones and peschok," was also owned by another member of the family, William, who was alive in 1560, but whether he preceeded or succeeded Andrew is uncertain.

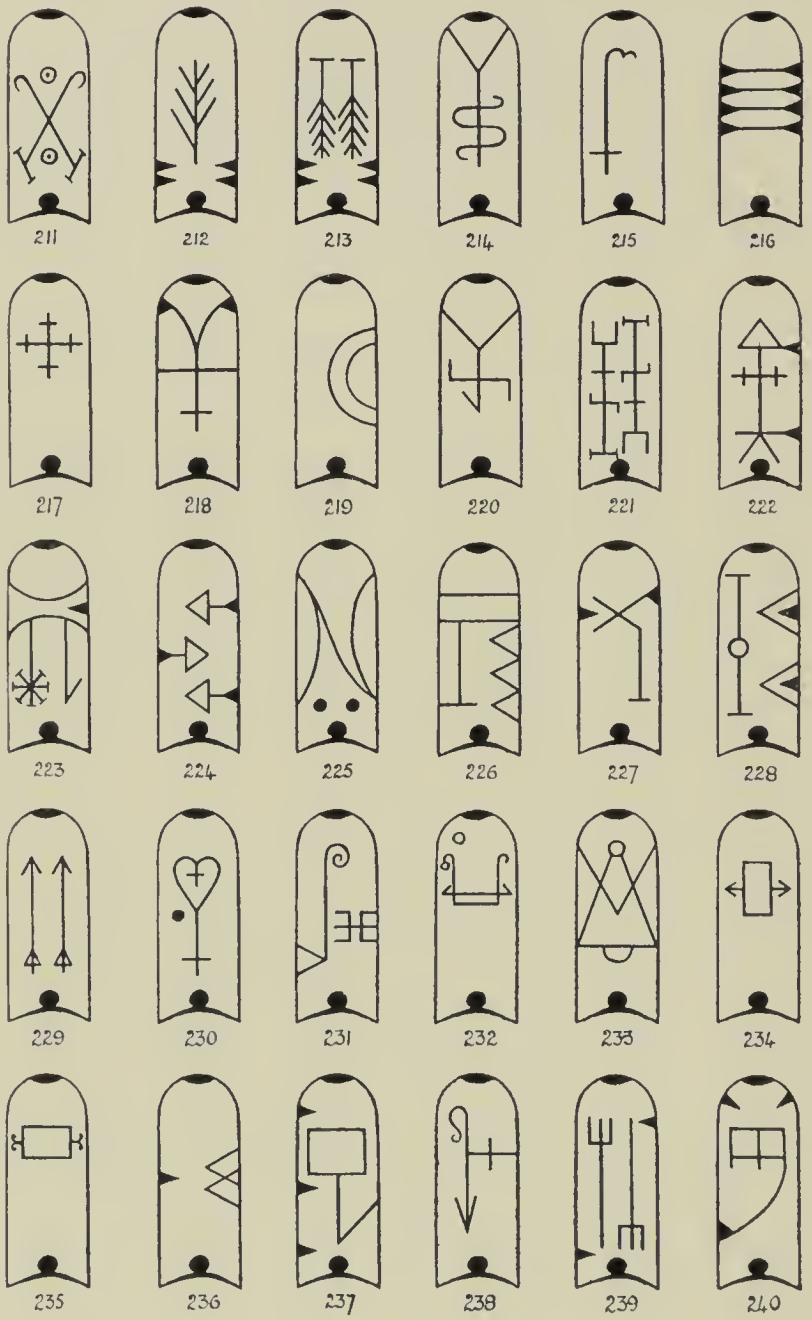
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FIGURE 7

224. John Welby, of King's Lynn, born 1577, married 1601. He succeeded John Dennis, whom I have not been able to identify, as owner of the mark in 1609, and was succeeded by Thomas Hedley of Brampton, in Huntingdonshire.

225. Richard Wetherley, of Thetford, Mayor in 1505 and coroner in 1506. The mark occurs on nearly every roll, but usually under the surname only.

226. John Whetholme, Vicar of Walpole St. Peter 1525, died 1537. He was succeeded as owner by Sir Thomas Tindall (*vide* No. 218) who was followed as No. 218 by Sir John and Miles. Sir John "differenced" by adding a fourth triangle, between the bars.

227. John Whetholme, *idem* (?).—This owner is entered in some rolls as plain John, but in one the entry is "Johes Whitholme mil:"—If this is correct I cannot find anything about him; but my impression is that it is a mistake made in copying from an earlier roll in which, as that of a parish priest the name had been written in the then usual manner "Sir" John.

The next owner was Thomas Waters of Lynn (*vide* No. 34) and a later one still was named Williamson, perhaps Anthony (*vide* Nos. 129 and 231).

228. John Whetholme, *idem*.—This mark had a long succession of later owners and the next in order belonged to Lincolnshire, viz.:—Ashton of Spalding and William Brian of Bolingbroke, who died in 1573. It then came back to Norfolk, being acquired by Francis Gawdy of Wallington (*vide* No. 88) who died in 1606. After him it was held by Dr. Cropley, John Hutchinson and Mr. Wriglesworth, none of whom can I identify.

229. John Whetholme, *idem*.

230. Henry Whinburgh, of Whinburgh, Yaxham, Garveston, Reymerston and Thuxton, whose will is dated 1544.

231. Anthony Williamson, of Kenwick in Tilney, *viv.* 1646. This mark, known by the name of "ye priars staffe, and . . (?)" had previously belonged to a succession of Wisbech owners, Henry Goodricke, Edward and William Wilkes. In spite of its character and name, its origin is not traceable, on the evidence available, to any monastic house.

232. John Willoughby, of East Hall, Denver, d. 1557, and his son and heir William.

233, 234, 235. Robert Wingfield, of Dunham Magna. No. 234 is also given for his son John Wingfield of Winch, who died in 1584.

236. Sir Roger Woodhouse, of Kimberley, succeeded his grandfather 1560, knighted 1578, died 1588.

237, 238. Thomas Wynde, of South Wooton, *viv.* 1602.

239, 240. William Yelverton, of Rougham (d. 1541) and/or his son William, who died in 1587.

IV

REPORT OF THE BLAKENEY POINT RESEARCH STATION, 1927-1929

By F. W. Oliver, F.R.S.

Further Notes on the Development of the Far Point

Some account of the history of the origin and modification in relief of the Far Point was included in the last Report (1924-26) as well as of the arrival and establishment of the pioneer plants and breeding birds. As the opportunities are limited in which new land is arising and the settlement thereon of pioneer populations can be recorded, the dates of arrival of the various species of plants and animals have been included in the table which follows :—

First Records

Year.	Species of Plants.	Nesting Birds.
1918	None	None
1919	Arenaria peploides*	Common Tern*
	Psamma arenaria*	Little Tern*
	Salsola Kali	Ringed Plover*
	Triticum junceum*	
1920	Cakile maritima*	Sandwich Tern*
1923	Plantago maritima	Arctic Tern
	Polygonum aviculare	Roseate Tern
1924	Armeria maritima	

*Becoming numerically important.

First Records—continued

Year.	Species of Plants.	Nesting Birds.
1925	Artemisia maritima	Redshank
	Glyceria maritima	
	Obione portulacoides	
	Salicornia europæa	
	Silene maritima	
	Suæda fruticosa*	
1926	Atriplex glabriuscula	
	Atriplex littoralis	
	Carduus arvensis	
1927	Aster Tripolium	
	Beta maritima	
	Sedum acre	
	Senecio Jacobæa	
	Senecio vulgaris	
	Statice reticulata	
	Trifolium sp.	
1928	Elymus arenaria	Oyster Catcher

This synchronising in the appearance of plants and birds probably means no more than that by 1919 the beach having emerged sufficiently to provide the necessary stability, plants established automatically from the drift lines and terns came to take possession of new vacant ground, admirably situated from the point of view of food supplies.

Nutritively, the terns have no direct need of plants, whilst as cover the plants present at the time were negligible.

Dune Building

Shingle as originally piled up is relatively free of sand, but with lapse of time sand is blown from the foreshore and riddled through the open-textured surface into the interior of the beach. As vegetation establishes the tendency is for much sand to be held on the surface, with eventual production of dunes. In this connection the behaviour of the leading plants is different and complementary ; this is well illustrated by the appropriate stages of dune development on the Far Point.

By "leading plants" are meant *Triticum* (*Agropyrum*) *junceum* and *Psamma arenaria* (Marram Grass) of the perennials,

*Becoming numerically important.

and *Cakile maritima* and *Salsola Kali* among the annuals. In addition to these *Arenaria peploides* forms low, cushion-like dunes in which the sand is securely held.

In our case original colonisation was largely by Triticum and Psamma, from seed left on the drift lines, especially in 1920-22. As it happened, by the luck of the deal, the first area colonised (line *x*, text-fig 1.) consisted mainly of Psamma, whilst in 1922-23 the extension along axis *y* was chiefly Triticum. This chance occurrence has the advantage of making perfectly evident the differences in dune building procedure proper to these two species of plants.

TEXT-FIG. 1. Chart of Far Point, showing hooks 1 to 5. The lines *x* and *y* mark the axes of the two original vegetated areas in the order of their appearance ; *x* mainly Psamma, *y* mainly Triticum. The vegetation has spread in all directions since. The distance from left to right of chart is half a mile.

Broadly speaking, whilst *x* (under Psamma) had a two years start of *y* (under Triticum), the latter area has quickly overtaken the former, so that by 1927 a much larger portion of the Triticum area was covered by small dunes than in the case of the Psamma (Typical Triticum dunes are shown in two stages on Pl. 1).

Differences between Triticum and Psamma

In the first place Triticum is a halophyte, whilst Psamma is not. That is to say when the Far Point is overrun by a very high tide, the Psamma leaves are killed, whilst Triticum is unaffected. Where the ground is concave and the sea water remains, the Psammas may be killed out altogether. This difference in osmotic organisation renders Psamma less fitted

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Triticum dunes arising on the Far Point in 1925

The same view as above, 1927

as a pioneer in colonisation at levels near high water mark. But in addition Psamma is in other respects less well equipped for operations at this stage. The leaves of Triticum are prostrate and tend to cover and shelter the sand hummock, whilst those of Psamma stand bolt upright, like a shaving brush. As a consequence, with changes in the direction of the wind, the Psamma hummocks lose much more of their collected sand than do those under Triticum. Nor is this all. Both species form underground runners (stolons) freely, but Triticum produces them deep in the shingle, whilst Psamma forms them mainly in the removable pile of sand it has collected. In consequence, when the wind blows sand away, there is much greater liability to exposure of the runners of Psamma, with eventual wind pruning, than in the case of Triticum. The result is that Triticum hummocks rapidly spread so that in a few years a single seedling may form a dune 15-20 ft. across, and 3-4 ft. in height (cf. Pl. XLVI).

Psamma on the other hand does not spread like this, and for years remains in the shaving brush phase, unless something happens to bring and retain around it quantities of sand. In other words, whilst Psamma branches preferably into pure sand or very sandy shingle, Triticum is perfectly at home in shingle with a moderate admixture of sand.

The further History of Psamma

Psamma remains in a state of arrested development until sand is *made to stay* around it Sand is brought in two ways.

1. By the establishment of seedlings around the original plants further dune forming units become available, and as these grow, their little dunes blend with the original one so that a composite structure arises, the several parts of which give one another mutual protection.

2. The same result is reached when some *other plant* does the work of holding the sand around the Psamma. Most efficient in this is Cakile (occasionally Salsola), the plants of which sometimes arise in dense aggregation, building up low dunes (under 1-ft.), and having the further advantage that although Cakile dies at the end of the summer its persistent dead body continues to hold the sand through the winter. This quasi-permanent patch of sand the Psamma utilises to push its

stolons, and eventually occupies the whole ground. The function of Cakile in dune building is thus a conspicuous one, as it enables Psamma to become effective much sooner than would be the case had it to wait till its own seedling offspring come to the rescue. (Pl. XLVII., lower photo, shows isolated marram plants with matrix of blown sand held by Cakile of preceding year).

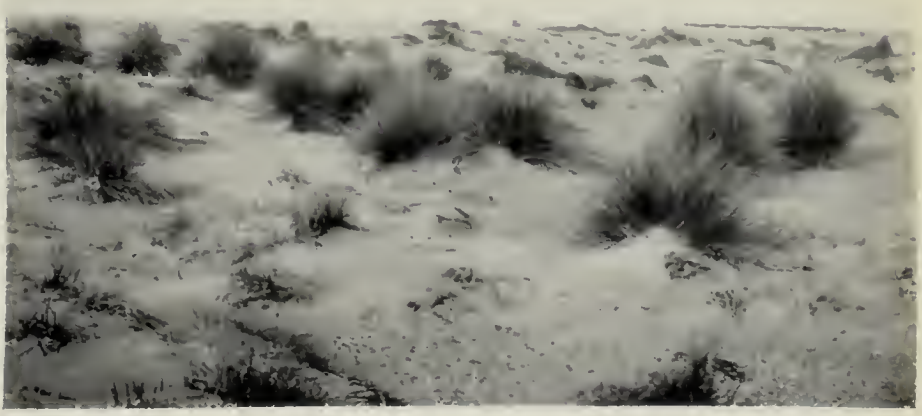
Occasionally, when Psamma seedlings are produced in quantity their joint action in holding the sand is extremely marked. Thus in the autumn of 1928 the full grown plants of Psamma ripened great quantities of seed, which, being scattered round about by the wind, germinated profusely to form in 1929 continuous lawns of seedlings occupying the bays and spaces between. By July these young plants, often present to the number of 80 per sq. yard, had 5 or 6 leaves and were about 6-ins. high. Sand was being actively collected and was already about 3-ins. deep (cf. Pl. XLVIII., lower photo).

Thus we see that observations on the Far Point contribute important links in the chain of events leading up to well grown sand hills. Triticum thrives conspicuously at first, building up hillocks to about 4-ft., which spread rapidly; but in the long run, when Psamma gets entrance, the Triticum is overwhelmed and is rarely to be found on a fully-grown dune.

For some reason, not ascertained, Triticum thrives best at not more than a few feet above beach level—perhaps questions of water supply are involved—and in the end fails in competition with Psamma. The point to be noted is that Triticum is the true pioneer, whilst Psamma (although it may establish as a pioneer) is unable to make good till supplied with ample sand either by other plants or by a multitude of its own offspring. In other words Psamma belongs to a later phase (or "succession") of the sand dune formation, than Triticum.

The stage which the colonisation of the Far Point has now reached is very interesting. The proximal portion (*x*, Text-Fig. 1) is largely under Psamma, whilst further West (*y*, Text-Fig. 1), though Triticum is yet dominant, the Psamma is beginning to get a footing in the sand hills which Triticum has built up. Still further West are young, isolated dunes (mostly under Triticum), and beyond these bare shingle recently thrown up. In the aggregate the Far Point provides ideal

Aerial view of Blakeney Point Headland, seen through fleecy clouds; Morston Marshes in front of picture



Marram Plants with continuous mantle of sand held by associated Kakiles of previous season

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ground for the demonstration of all the earlier phases of dune building, and it is to be expected that in the near future (apart from some catastrophe) marked vertical rise of these sandhills will be apparent.

Differentiation of Habitats

From a more general point of view, the area commands attention as illustrating different types of maritime habitat in process of differentiation. At first we have a succession of beaches of shingle thrown up, of which some parts are slightly higher than others; whilst between are minor discontinuities or gaps in the system of construction. Plants spring up where drift lies and this is mainly, through the law of buoyancy, along the crests and higher slopes. As yet the future distinctive habitats are not differentiated, and one finds at this stage a *mixed* community of plants of which the individual species are usually to be found on dunes, or bare shingle, or in salt marshes. Thus, such a typical salt marsh plant as *Aster Tripolium* will be found establishing on pure shingle—possibly on a buried layer of drift which for a time holds the necessary moisture. This is no incipient marsh, and as conditions change by drying out and the addition of blown sand, the Asters will depart.

Elsewhere, at rather lower levels accessible to tides, silting will regularly occur and the beginnings of a salt marsh habitat come into being. On these, presently, Salicornia, Vaucheria, etc., will appear. A good example of a partly covered salt marsh is to be found just west of the point where the "Caretaker" is anchored. This is the work of about five years. We find that once the annual *Salicornia europæa* gets a footing it faithfully reproduces by seed, most of which falling on the mud close by, ensures recurrent establishment from year to year.

Elsewhere are incipient "lows"—little valleys cut off from all but the highest tides—and in some of these have already appeared such characteristic members of this type of habitat as *Statice reticulata*.

THE TERNERY.

The nesting ground on the Far Point has continued to prosper during the three seasons under review, the number of Sandwich Terns in relation to Common showing a continuous increase.

It is difficult to make an accurate estimate of the number of birds, but 4,000 Terns of all five species should not be far from the mark. The numbers culminated in 1928, though 1929 is not far behind. The Roseate Tern has now bred with us (usually 2 pairs) without intermission since 1923. In 1929 2 pairs nested near their usual spot, and one chick was safely reared from each of the nests. (Photo of Sandwich Terns on Pl. XLVIII.)

Though the 1929 season started late the ground was well covered with nests by the end of May. Cold weather and strong winds in June were responsible for some losses among the young chicks; but on the whole the season has been a good one.

As in 1928 Redshanks, and one pair of Oyster Catchers successfully brought off their chicks on the same area.

The small, covered houseboat "Caretaker," which has been moored on the breeding ground, has proved most useful as a base for the closer supervision of the ground. It is also a good observation point, and provides sleeping quarters for the Watcher during the season.

Matters of Policy

As regards terneries, bird sanctuaries, nature reserves, and the like, no standardised procedure has yet been reached. There is the one extreme favoured by the Swiss in their great National Park in the Engadine which is treated as an absolute sanctuary, never disturbed by man apart from the periodic, authorised visits of experts to record progress.

The other extreme is illustrated by our own ternery When the National Trust took over in 1912, no Far Point was in existence. The Terns bred mainly in Great Sandy Low (to the seaward of the Laboratory) and consisted of about 1,000 pairs of Common Tern and 100 Little. With the development of the Far Point, Terns began to nest there in tentative fashion in 1919, and from year to year in increasing numbers. To-day practically all nest here, and include the five species, Sandwich, Common, Roseate, Arctic and Little. The outstanding feature is provided by the Sandwich Terns, which are probably to be seen here under more favourable conditions than anywhere else in the British Isles. The policy of the National

Sandwich Terns on Blakeney Point, from a photograph by Mr. Geo. Marples

Lawn of Marram seedlings arising alongside established Marram plants, 1929

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Trust, as interpreted by its Blakeney Point Committee of Management, has been definitely to maintain the ternery as such, and to give it protection by destroying ground vermin and by discouraging such birds as are destructive of Terns, their eggs or young. Crows, Black-headed Gulls and Little Owls are consistently removed. The Gulls, for instance, are prone to pick up the young chicks, and at a safe distance devour them. Owls will even behead the sitting birds.

Our Watcher, Mr. R. J. Pinchen, does everything possible to protect the Terns from their foes, with the result that collectively they form a magnificent and inspiring spectacle, whilst providing incomparable material for study in a variety of fields. One of these, as yet hardly explored, is the scientific study of the social relations of the members of this great assemblage of birds.

Visitors, expert and non-expert alike, are admitted to the ternery, and so long as there is no evidence that the birds suffer, this policy will be continued. It is not necessary to be a trained naturalist to be tremendously impressed by the grandeur of the spectacle; and the inspiration of a visit is a thing not likely to be forgotten, especially by the young. We believe therefore that our policy of giving admission to this unique spectacle is the best propaganda for implanting and encouraging a love of nature.

There is just one restriction we would wish the public to observe, viz., to refrain from visiting the ternery after 7 p.m., so as to give the birds a chance. This regulation will come into force in 1930.

Our neighbours at Scolt Head have pursued latterly yet another policy. Here also Terns breed, sometimes in large numbers. Excepting Gulls, all birds are welcomed—Owls, and even Harriers, if they will. It is left to Nature to determine which shall be the survivors. The experiment is the more interesting, as the two terneries lie near enough together to be visited on successive days, and results compared. At Scolt Head, non-intervention is not pushed to the point of excluding human visitors.

Influence of the Tern Colony on New Soils

The presence of so many birds nesting gregariously for three months of the year on a small area of ground like the

Far Point must have a marked influence on the development of the soil, especially in the direction of enriching it with combined nitrogen derived from their food.

The available sources are (1) the fish ("whitebait" and young sand eels) consumed by the old and young birds, which reaches the soil in the form of droppings (conspicuous everywhere about the nests in the case of the Sandwich Tern); (2) the unconsumed fish left lying about; (3) the bodies of such chicks as die on the nesting ground in cold and windy periods; (4) the bodies of insects, etc., which feed on the dung.

To investigate the matter a few preliminary determinations of nitrogen in these soils were made in 1927. The materials were collected in July by Dr. Mukerji and supplemented by a November collection, whilst the actual determinations were made by Miss R. Dowling of University College.

The method was as follows.—A large Triticum dune on the Far Point (about 25-ft. long) where Sandwich terns were known to have nested for 5 years was selected, and about 30 samples of soil were taken from 2 to 6 inches depth; and from the mixing of these the determinations were made.

As a control, a similar dune of like age was chosen near the Boathouse, where birds do not nest, and the soil samples were treated in precisely the same way.

The loss on ignition in the soils from the nesting ground averaged .65 per cent., and in the soil from the Boathouse dune .26 per cent. Further samples from the nesting ground taken in November showed a loss on ignition of .48 per cent., this diminution (.17 per cent.) being attributable partly to leaching by a very high autumn tide which partly submerged our Triticum dune, partly to the admixture of additional wind-carried virgin sand.

Nitrogen is present in all samples from the nesting ground (July) in three forms, viz., nitrates, ammonium salts, and protein. The November samples of the same show a marked fall in ammonium salts, which have probably undergone leaching, whilst in the Boathouse dune, though nitrates and protein are present, no ammonium salts were detected.

The presence of phosphates was also verified but not determined quantitatively.

The carbonates present in all soils were about the same, and showed no significant diminution in the winter samples.

The amounts found were .48 per cent. nesting ground (July), .47 per cent. (November); Boathouse dune (July) .43 per cent.

These preliminary observations serve to show that the presence of the birds has a marked effect on the nitrogen content of the soil of the nesting ground, and forms a basis for possible change in the flora comparable to that of the bird islands in Spitsbergen.*

This enriching of the soil *ought* to have some effect on the vegetation, but there are other factors in operation which stimulate the leading plants and we are not yet in a position to differentiate between them. The leading plants are Triticum and Psamma, and both grow and flower with the utmost vigour—conditions which are also promoted by shingling and sanding over, and in general by hard buffetting. So we shall have to wait and see whether particular species of plants appear in the next successions on the manured ground.

We have been impressed with the rapidity of colonsation of the Far Point by new species of plants (see Table, p. 630), but this I incline to attribute to tidal drift rather than to any interference by the birds.

The Algæ of Blakeney Point

The lists and notes, which are printed here for the first time, were drawn up some years ago by Mr. A. D. Cotton, Keeper of the Herbarium of the Royal Botanic Gardens, Kew, who worked partly with University College parties, partly on independent visits at other seasons.

The total number of marine and salt marsh species enumerated reaches about sixty—a high figure for a sandy and muddy foreshore such as the Point and Harbour of Blakeney provide. This richness in forms depends especially on two circumstances; (1) The presence of mussel beds in the harbour which give secure anchorage to many species, especially of red algæ, and (2) The great variety of algæ which enter as components of the salt marshes, especially habitat forms of brown seaweeds. These latter formed the subject matter of the researches of the

*V. S. Summerhayes and C. S. Elton. Further contributions to the Ecology of Spitsbergen, Journ. of Ecol., 1928, pp. 238—247.

late Dr Sarah Baker, and were described in conjunction with Mrs. Blandford, in Blakeney Point Publication, No. 16.

To complete the list of our algæ the freshwater forms are required. These are accessible only on the rare occasions when freshwater stands for some time on the Point, the principal localities being Glaux Low and Long Low, which lie to the N.W. and S.E., respectively, of the Laboratory. These forms, which are not numerous, have yet to be worked out in detail. The late Prof. G. S. West examined a few samples in one of which he discovered a new species, *Carteria Oliveri* (cf. our Report, 1915-16, p. 12); but the investigation of the remainder has never been completed.

The only permanent source of freshwater on the Point is the Well, dug at the Boathouse end of Long Low to the W. of the Flagstaff. This is kept covered and does not yield algæ.

List of Marine and Salt Marsh Algæ

Cyanophyceæ

Chlorococcus turgidus, Naeg., epiphytic on various algæ.

Spirulina subsalsa, Oersted.

Oscillaria limosa, Ag. Common in pans. Sometimes holding sand and forming plateaus.

Lynbya aestuarii, Liebur. Very common forming pure felts or mixed with other species in large felts.

Lynbya confervoides, C.Ag., not uncommon in felts, especially in summer.

Lynbya semiplena, J.Ag.

Lynbya majuscula, Harv., epiphytic and free floating.

Microcoleus chthonoplastes, Thur., abundant at certain levels as a mud and sand binder.

Microcoleus tenerrimus, Gom., rare.

Calothrix confervicola, Ag., epiphytic.

Rivularia atra, Roth., on firm ground at the Hood.

Rivularia nitida, Ag.

Microchæta æruginea, Batt., epiphytic.

Anæbæna torulosa, Lagerh, occurs as greenish black discoid or circular colonies on mud.

Chlorophyceæ.

Protoderma marina, Rke., on stones under Aster.

Percursaria percursa, Rosenv., a not infrequent species in felts, though not in large quantity.

Monostroma sp.

Monostroma Grevillei, Wittr., abundant in spring on algæ and pebbles in channels.

Enteromorpha intestinalis, Link , abundant.

Enteromorpha compressa, Grev., abundant.

Enteromorpha micrococca, Kütz., common near h.w. mark.

Ulva Lactuca L., common in main channel on mussels, and in free floating form ; (*var. latissima*) in dikes on Salthouse marshes.

Ulothrix pseudoflacca, Wille., frequent on Fucus vesiculosus.

Ulothrix flacca, Thur., frequent.

Chætomorpha ærea, Kütz., abundant in dikes on Salthouse marshes.

Chætomorpha linum, Kütz., rare.

Rhizoctonia riparium, Harv., not uncommon.

Cladophora sericea, Kütz., not uncommon.

Cladophora gracilis, Kütz., a form apparently referrable to this species, not uncommon.

C. fracta, Kütz., in felts and washed ashore.

Vaucheria Thuretii, Woron, not uncommon especially on Samphire Marsh (S. of Hood) where it forms apparently a fairly broad zone about 30 yards wide and 3-4 feet deep.

Vaucheria squandra, Woron, apparently rare.

Vaucheria sphærospora, Nordst., apparently rare.

Vaucheria coronata, Nordst., not uncommon ; once at very high level (Glyceria).

Species of *Vaucheria* can only be determined when the reproductive (sexual) organs are present. Several scores of samples were taken at various dates and at various levels. These were washed out later at Kew and examined, and the four species named were found.

PHÆOPHYCEÆ

Phœococcus adnatus, West., occurs on mud banks near H. W. M.

Punctaria latifolia, Grev., scarce, a few specimens found in April.

Phyllitis fascia, Kütz., not uncommon on pebbles in channels in Spring.

Ectocarpus littoralis, Kütz., not uncommon.

Ectocarpus siliculosus, Kütz., not uncommon.

Ectocarpus Hincksii, Harv., rare, on Lam. Saccharina.

Elachista fucicola, Fr., a few specimens found.
Myrionema strangulans, Grev., on Ulva Lactuca.
Chorda filum, Stackh, in the main channel.
Laminaria Saccharina, Lamx, in the main channel.
Fucus vesiculosus, L.
Fucus vesiculosus, var. *volubilis*.
Fucus spiralis, L.
Fucus serratus, L., in main channel.
Pelvetia canaliculata, Decne et Thur.
FLORIDEÆ
Erythrotrichia carnea, J.Ag., epiphytic.
Porphrya umbilicalis, Kütz., in main channel.
Chantransia virgatula, epiphytic on various algæ in the main channel.
Catenella opuntia, G. and W., on Suæda fruticosa.
Gracilaria confervoides, Grev., in main channel.
Polysiphonia nigrescens, Grev., in main channel
Polysiphonia elongata, Grev., in main channel.
Polysiphonia urceolata, Grev., in main channel.
Polysiphonia atro-rubescens, Grev., in main channel.
} On large stones in the scour near Lifeboat House.
Bostrychia scorpioides, Mont., on Aster, etc., in creeks. May be attached to Pelvetia or forming a mulch.
Callithamnion roseum, Harv., Epiphytic on various algæ. In main channel in Spring.
Ceramium rubrum, Ag., in main channel.

The bed of the main channel itself is for the most part sandy, and owing to strong tidal scour is, except for stones or where the ground is held by mussels, devoid of vegetation. Mussels occur immediately below the Lifeboat House (and also further west) and they provide the finest purely marine vegetation on the area.

In the spring the growth is fine and luxuriant, though only composed of about a dozen species ; in the summer it is still copious, although the delicate red forms have disappeared, and there is much diatom growth.

The dominant species in spring are *Ulva Lactuca*, *Ceramium rubrum*, *Polysiptonia nigrescens* and *P. elongata*. On the mussels more to the west, where they stretch right across the channel, there are in addition, *Polysiphonia atra-rubescens*,

P. urceolata, Ectocarpus littoralis and *E. siliculosa, Porphyra umbilicalis, Fucus serratus, Laminaria Saccharina,* with *Ectocarpus Hinksii, Enteromorpha intestinalis, Callithamnion roseum, Gracilaria confervoides,* and *Cladophora* sp. As is usual in rapidly running water, the plants are characterised by great length—*L. Saccharina* 8-10-ft., *Porphyra* 4-ft., *Ulva* 2 -ft., *Enteromorpha* 3-ft., *Polysiphonia elongata* 1 -ft. In spring, when the plants are young and in good condition, the effect on a fine day of *Polysiphonia* and *Callithamnion* against the bright green background of *Ulva* is equal to rock pool scenery. It is seen at its best at the close of the ebb. In summer, all the *Polysiphonia* disappears except *P. nigrescens,* and apparently the only additional species is *Chorda filum,* which develops in abundance.

The luxuriant growth here is due to the solid substratum provided by the mussels and the never failing current bringing a constant supply of oxygen.

Bryophytes and Lichens

During July, 1927, Mr. Paul W. Richards, a member of the Department of Botany, made an ecological investigation, especially of the Bryophytes. The results of this have recently been published in the Journal of Ecology (1929), and reprinted as Blakeney Point Publication 29. Mr. Richards also revised the systematic enumeration of our Bryophytes and Lichens, in connection with lists drawn up by W. H. Burrell, W. Watson and V. S. Summerhayes (Bryophytes), and by R. C. McLean and W. Watson (Lichens).

These lists as revised by Mr. Richards are here appended.

The dune ridges are named according to the lettering on the map published in B.P. Report, 1924-26, p. 2.

Musci

1. *Polytrichum piliferum* Schreb. Old grey dune and on neighbouring high shingle, Hood : on shingle near the "Yankee."
2. *P. juniperinum* Willd. Grey dunes and neighbouring shingle, Hood.
3. *Ceratodon purpureus* Brid. Abundant on grey dunes, older white dunes and high shingle in most parts of the Point.

4. *Dicranum scoparium* Hedw. var. *orthophyllum* B. and S. Locally abundant on older grey dunes (C, B, and Hood) ; a very few young plants on D.
5. *Grimmia pulvinata* Smith. On shell in high shingle, Hood, *Watson.*
6. *Tortula muralis* Hedw. High shingle, Marrams, *Watson.*
7. *T. subulata* Hedw. Outer part of dunes, Hood, *Summerhayes.*
8. *T. ruraliformis* Dix. Abundant on the older white dunes ; frequent on the high shingle and grey dunes except where very old and undisturbed (as on parts of C, D, H and at the Hood)
9. *Trichostomum flavovirens* Bruch. On high shingle, descending into the zone of *Suæda fruticosa ;* Marrams, main bank and Hood ; sparingly in Long Low.
10. *Funaria hygrometrica* Sibth. High shingle, Marrams. *Watson.*
11. *Bryum pendulum* Schp. On shingle, main bank near the Marrams, with fine fruit in 1927.
12. *B. Warneum* Bland." Probably ; but without capsules." High shingle, Marrams, *Watson.*
13. *B. inclinatum* Bland. Grey dunes (hollows at Headland), *Watson ;* on high shingle, main bank at the Marrams.
14. *B. pallens* Sw. Fruiting on shingle, main bank ; a plant with imperfect fruit from the grey dunes probably also belongs here.
15. *B. turbinatum* Schwaeg. "Probably; but no fruit." High shingle, Marrams, *Watson.*
16. *B. capillare* L. Grey and derelict dunes and on high shingle, Marrams, *Watson.* Probably frequent on the dunes, but no fruiting plants were seen in 1927.
17. *B. Donianum* Grev. Grey dune, top of Long Low, *Watson*
18. *B. argenteum* L. High shingle, Marrams ; grey and derelict dunes, *Watson ;* a few young plants in Glaux Low. var. *lanatum* B. and S. Dunes, *Watson :* here and there on the dunes, sepecially on E. Nearly all the plants of the species examined belonged to this variety.

Other species of this genus probably occur, but cannot be identified, owing to the lack of fruit.

*These were published in the Blakeney Point Report in 1914.

19. *Brachythecium glareosum* B. and S. Grey dune, Headland, *Watson :* outer edge of dunes, Hood., *Summerhayes.*
20. *B. albicans* B. and S. High shingle, Marrams, *Watson :* abundant on older white dunes, frequent on grey dunes.
21. *B. rutabulum* B. and S. Marrams, *Watson :* main bank ; grey dune (D and Hood).
22. *B. purum* Dix. Grey dunes, hood.
23. *Eurhynchium prælongum* Hobk. "Grey dune, often in shade of *Psamma ;* abundant, *Watson.* Not seen there in 1927. Shingle, main bank and Marrams: old grey dunes, Hood (chiefly among *Juncus maritimus*).
24. *E. confertum* Milde. High shingle, Hood, *Watson.*
25. *Amblystegium serpens* B. and S. High shingle, Marrams. *Watson :* main bank.
26. *Hypnum cupressiforme* L. Grey dune, abundant ; with *Corynephorus,* abundant; high shingle, abundant, *Watson.* The only specimens I have seen which did not belong to one of the following varieties came from the old grey dunes at the Hood.
    var. *ericetorum* B. and S. Old grey dunes, Hood.
    var. *tectorum* Brid. Abundant on the dunes (Hood, B-D. Very rare on E).
    var. *elatum* B. and S. Old grey dunes, Hood.
27. *Hylocomnium splendens* B. and S. Grey dunes, Hood, *Watson.*
28. *H. squarrosum* B. and S. Grey dune, Hood, *Burrell* and *Watson.*
29. *H. triquetrum* B. and S. Grey dune, Hood.

Hepaticæ

30. *Lophocolea cuspidata* Limpr. Old grey dune, Hood.
31. *Cephaloziella Starkii* Schiffn. (=*C. byssacea*). Old grey dune, Hood, in shelter of *Psamma* on grey dune C.

Lichens

A number of lichens not previously recorded for the Point were found by Dr. Watson in 1920. A list of them, copied from his manuscript notes, is given below, together with a few records made by Mr. Richards. Five new species were found in 1927. Two of them were represented by a very few small specimens only and were presumably new arrivals. It is

remarkable that both these species usually grow on the bark of trees.

Collema glaucescens Hoffm. "Grey dune near Long Low. Material insufficient to make determination certain."

Peltigera canina Willd. Grey dunes.

P. polydactyla Hoffm. Grey dunes.

Parmelia physodes Ach. forma *labrosa*. Present with type on grey dunes. var. *tubulosa* Mudd. Present with type on grey dunes.

P. caperata Ach. One plant on dune E, *Richards*.

P. fuliginosa Nyl. "The very dark typical form of rocks was not noticed. All the specimens I examined on the high shingle of Marrams and Hood belong rather to var. *laete-virens* Nyl."

Usnea florida Web. var. *hirta* Ach. One plant on grey dune D and another on C, *Richards*.

Placodium lobulatum A.L.Sm. "Very abundant with *Verrucaria maura* in very low shingle, occasionally on shells and stones on high shingle. This is probably the *Lecanora citrina* or *L. incrustans* of McLean's paper."*

P. (*Callopisma*)*phloginum* A.L.Sm. On drifted wood, high shingle, Hood.

P. (*Callopisma*) *cerinum* Hepp. On *Suæda* stems, high shingle, Hood.

Rinodina demissa. On pebbles and shells, low shingle, Marrams and Hood.

"*R. exigua* of McLean's paper refers to the preceding (*R. demissa*). The specific name *exigua* is now usually restricted to lignicolous forms."

Lecanora Hageni Ach. "Low shingle on decaying leaves of *Suæda*, etc. High shingle on *Suæda* stems (often almost crusted with *Pleurococcus viridis*) and drifted wood.

L. umbrina Massal. On shell, high shingle. "Probably frequent."

Lecania prosechoides Oliv. Low shingle, Marrams, Long Hills and Hood ; high shingle.

L. prosechoidiza A.L.Sm. Low shingle between Long Hills and Hood ; high shingle.

*McLean, R. C. The Ecology of the maritime lichens at Blakeney Point, Norfolk. *Journ. Ecol.* III., 1915.

L. erysibe Mudd. Low shingle between Long Hills and Hood.

Cladonia rangiferina Web. "Not noticed." Also not seen in 1927.

C. pyxidata Hoffm. var. *chlorophæa* Floerke. Grey dunes. forma *lepidophora* Floerke. Grey dune.

C. fimbriata Fr. Grey dunes, *Richards*.

C. furcata Schrad. var. *scabriuscula*. Grey dune.

C. rangiformis Hoffm. Grey dune H and probably elsewhere, *Richards*.

C. Floerkeana Fr. Locally abundant on the grey dunes. *Richards*.

Lecidea uliginosa Ach. On decaying mosses and ground with humus, grey dune, Hood; bare patches on bound shingle with grasses, etc., Marrams. Also on dune ridge C in 1927, *Richards*.

L. expansa Nyl. Bound high shingle, Marrams.

Bacidia muscorum Mudd. On decaying mosses, high shingle,

L. expansa Nyl. Bound high shingle, Marrams.

Bacidia muscorum Mudd. On decaying mosses, high shingle, Hood.

B. inundata Koerb. On low shingle near *Suæda*, Marrams.

Buellia spuria Koerb. On shell, high shingle, Marrams.

B. myriocarpa Mudd. On drifted wood, Hood.

Rhizocarpon confervoides D.C. The common form is forma *cinereum*; forma *albicans* was noticed on low shingle, Hood.

Lecania Nylanderiana Massal. "A plant found on pebbles on the margins of the Pelvetia marsh is probably referrable here. It differs in some respects but, considering the material I have, I do not feel inclined to create a new species for it."

We have to thank Miss A. Lorrain Smith and the Referees of the British Bryological Society for several determinations.

Floral Biology

Latterly attention has been given to various features connected with the biology of reproduction of selected species of flowering plants on the Point.

Thus, one of the species selected for intensive study of the duration of individual flowers and the opening and closing times of floral members showing periodic movements was

Erodium neglectum, the results respecting which will serve to illustrate the kind of phenomena investigated. The flowers last about three days, opening about 7 a.m. and closing between 11.30 and 1 p.m. On the third day, however, from 10 in the morning to about 2 in the afternoon the petals are shed in succession at intervals ranging from five to ninety minutes. Usually this shedding starts soon after eleven. The flowers are usually slightly protogynous but, rarely, protandrous individuals occur; in either case, however, the stamens dehisce in two groups, and not infrequently some of the anthers are shed before dehiscence.

Similar studies carried out on other species shewed that the different individuals of a species may vary in respect of the incidence of these periodic phenomena.

A number of the shingle species were also studied with respect to the normal seed output and shewed the great range in productivity between species and species. *Senecio Jacobæa*, which is one of the commonest of the dune plants, and in some years occurs in great numbers, may produce as many as 32,800 fruits on a single individual, and even average-sized plants will produce over seven thousand. By contrast, *Convolvulus Soldanella* spreads almost entirely by vegetative means and the seed output is small, as not only is the number of seeds per capsule small (3-4) but a large proportion of the flowers are infertile owing to the reproductive organs having been bitten off by rabbits. A few examples from the shingle flora well illustrate the wide range in respect of seed output. *Rumex crispus* v. *trigranulatus* produces from 4,000 to 25,000 fruits, *Beta vulgaris* up to 130,000, whilst *Lepturus filiformis* has a fruit output of only about 9 to 90 per plant, and *Statice binervosa* has a seed output that averages about 400 and rarely exceeds 1,000. These data however only present a partial picture and the percentage germination of most of these species has yet to be determined.

Blakeney Point from the Air

Ever since the Air Survey of Blakeney Point was undertaken in 1921-22, it has been my ambition to see the Point from aloft. The opportunity came on August 19th, 1928, when, accompanied by one of my sons who holds a pilot's certificate, we flew

over from Mousehold in one of the Moth machines of the Norfolk and Norwich Aero Club.

We took off punctually at 4 p.m., and thanks to the Moth's fine climbing powers, quickly reached the comfortable height of 2,500 feet. As ever on these occasions, the untidy edges of parcels of ground had vanished, there was no appearance of sordidness visible anywhere, and except for our two selves, the human ant was off the map. Spread below was a patch-work of angular pieces like the choicest fabrics; this was Norfolk in harvest time. Standing grain crops, others partly cut, or in sheaf; all different shades of yellow, buff or silver, with splashes of green where the weeds showed through. The network of hedges was made conspicuous by little toy brooms which were trees. Marlpits in the fields stood out, and so too ponds and lakes, whilst parks like Gunton and Blickling, formed oases in the Joseph's coat of many colours of arable. It is the duty of a pilot continually to select good ground for a possible forced landing, and for this purpose (luckily not required) fields with midget sheep grazing were chosen. These promised a smooth landing; for Moths are not like Handley-Pages, capable of going through anything—even hedges.

Our course had been set by compass, and we made the coast between Sheringham and Weybourne, where the fore-shortened view of Blakeney Harbour spread itself below us to the west. The sun and cloud effects above were indescribable, and would need a Turner to do justice to them. At this height clouds have edges and upper surfaces, as well as the undersides familiar to dwellers on the ground. Coming lower, we passed over Salthouse—the Heath appeared deep purple, not crimson—and so by the inner edge of the beach, the Watch House, Hood and other well-known features of Blakeney Point (Pl. II., upper photo) to its recent extension, the Far Point, where the terns have their breeding ground. The birds still remaining looked from above like small grey insects crawling on the beach, and it was hard to realise that they, like ourselves, were in flight. The relief of the Far Point, with its rather formal curved beaches, looked clear cut like a model. The tide had about half ebbed, and the usual flotilla of boats was returning to Blakeney before the water should have run away. Individual boats were easily recognised.

Three outstanding things deserve mention. First, the apparent smallness of Blakeney Point, which on the ground seems a spacious territory. This is perhaps a consequence of the second, the exposure of every detail, bare and unobscured, at the same moment. The third was the wonderful colour scheme. All ground colours seemed modified. The sandhills with marram grass looked merely drab ; the younger marshes a most vivid green, the water in the channel and beyond, deep blue like a Pacific island lagoon ; whilst the yellow of the sands between the mouth and Wells was luminous, even dazzling. Some day a course of flying will be included in the education of every landscape painter.

An unexpected colour effect that may interest those having intimate knowledge of marsh zonation, was the inversion of the intensity of the green of the main Salicornia area and of the narrow, marginal *Suæda maritima* zone of the large Salicornia marsh which lies between the sandhills of the Headland and the Long Hills (" The Beach Way.") From the ground the Salicornia area appears a vivid green, whilst the marginal zone is not only less vivid, but rather glaucous in tint. From the air these colour relations are reversed. The marginal zone was, under the conditions of the visit, appreciably more vivid than the inner Salicornia area.

This effect is perhaps to be explained by the fact that the Salicornia plants, consisting as they do mainly of vertical succulent stems which are seen from the air end on, allow a good deal of the brown matrix of Pelvetia to become visible, so that the green colour undergoes dilution or rather contamination. On the other hand the *Suæda maritima* plants of the outer zone carry spreading foliage leaves, so that relatively less of the ground between becomes visible from the air.

Having circled once or twice round the flagstaff as a parting salute, we crossed the harbour and marshes on the Morston side, the meanders of the Agar Creek forming the most conspicuous and characteristic ground object. Blakeney shows well from the air, and the same is true of Holt, where we picked up the railway line to guide us back to Norwich. It is easy enough to hit the shore from Norwich, but to find this pin's point far inland needs guidance—the county as a whole being without conspicuous topographical features. The Cathedral

was disappointing as a landmark, nor did the roofs of Norwich show red, like Holt and Blakeney. It is not surprising that the Germans never found this city. Once in sight, however, the aerodrome, with its geometrical sheds and hangars, is very easy to recognise. Here we had to circle overhead for some minutes till the sheep, which had strayed all over the place, had been rounded up by the ground staff.

We are greatly indebted to the Officers of the N. and N. Aero Club for affording facilities for this flight, including the use of their new Moth machine.

Visit of Geographers.

On Sunday, July 22nd, 1928, some 60 or more members of the International Congress of Geographers, then meeting at Cambridge, paid a visit to Blakeney Point.

The party came over from Cambridge by road and were taken across to the Point in motor-boats from Blakeney and Morston. They were received on the Point by Lord Ullswater, the Vice-Chairman of the National Trust, who, in a happy speech—repeated in French for the benefit of those not too familiar with the English language—warmly welcomed the distinguished guests.

The party was split up into sections—those interested especially in coastal topography being shown round by Professor Oliver and Mr. E. H. Chater; others, whose interests were more in the direction of shore vegetation, were in the hands of Dr. E. J. Salisbury and Dr. Violet Anderson; and those ornithologically inclined were taken round the Ternery by Dr. S. H. Long. The occasion was one of great interest, not only from the point of view of seeing this shingle spit where problems connected with coastal erosion, etc., have been under investigation for so many years, but it was also the means of bringing into personal contact with the workers at the Blakeney Point Research Station many distinguished scientists from the Continent, America, and from Japan, who were previously only known to each other by repute or by correspondence. The party were entertained to tea at the Old Lifeboat House by Professor F. W. Oliver, his staff and students, and before leaving each guest was presented with an illustrated account of the Point as a souvenir of the visit.

Domestic Matters

The Point House

With the close of the 1928 season Mr. and Mrs. Pinchen withdrew from their tenancy of the Point House, at the same time relinquishing the catering in the tea room which they had held since 1923. As successors in the house the Committee have appointed Mr. and Mrs. Eales, and they are now acting as Joint Managers of the Tea Room. Mr. Pinchen retains his position as Watcher to the Trust. To Mrs. Pinchen and to her daughter, Miss Edith Pinchen, who helped her, the Trust are much beholden for the high standard maintained and in other ways.

Litter

In the last Report reference was made to the litter problem from which we suffer in a slight degree. And the suggestion was made that a picture poster would be helpful. A copy of this Report by chance came into the hands of *Fougasse*, the well known artist of Punch, and he most generously offered us a cartoon drawn for the purpose. This cartoon is used on the Point and has also been adopted by the National Trust for display on other of their properties. In agreement with our experience here, I understand that the *Fougasse* cartoon makes the right impression wherever it is used. It is also much in demand in Boy Scout and Girl Guide circles for educational purposes. To complete the 'good 'work young Teddy Eales has been appointed for the summer months " litter collector " of such trifles as survive the *Fougasse* caustic.

Landing Stage

For the convenience of visitors arriving by water a landing stage on wheels has been provided at the usual landing place.

Carnser

An unwelcome item of expense has been incurred through the collapse of the bridge on the Carnser at Easter this year. This ground belongs to the National Trust and one of the obligations of ownership is the upkeep of the bridge which we have reinstated.

Picture Post Cards

In previous years the Trust have issued series of picture post cards for sale among visitors, especially of bird subjects, many

being from negatives by Mr. R. Gaze. With a view to bringing these up-to-date, a further dozen was issued this year, including six studies of Sandwich Terns generously put at our disposal by Mr. George Marples of Liverpool. These have proved a great success, as well they might, being pictures of great beauty.

Gifts

The following donations of money, made since the issue of the last Report in 1926, are gratefully acknowledged. They have been credited to the Fund for the upkeep of the Laboratory, purchase of apparatus, and the like :—

Dr. Violet Anderson, £1 1s. 0d. ; Mr. Francis Druce, £2 2s. ; Dr. J. L. Gayner, £5 3s. 0d. ; Mr. A. H. Macdonald (for Library in O.L.B.H.), £3.

Such profits as accrue from the sale of Blakeney Point Publications and of picture post cards are credited to the same Fund.

Personnel of Committee

Owing to his migration from Norfolk to Oxford in 1928, Dr. Robert Gurney felt that he was compelled to relinquish the Chairmanship of the Committee, which he had accepted a few years previously. Dr. Gurney was an original member of the Committee and was always faithful to the interests of the Point, and we lose him with the greatest regret. His successor as Chairman is Mr. J. W. Castle.

Owing to my own absence in Egypt for some time, Dr. S. H. Long has kindly consented to act as Hon. Sec. to the Committee.

Committee for 1930.—Mr. J. W. Allen, Mr. S. E. Barker, Mr. T. W. Bourne, Mr. J. W. Castle, Mr. Walter Derham, Dr. G. Claridge Druce, Mr. W. A. Forsyth, Mr. R. M. Garnett, Mr. Quintin E. Gurney, Capt. L. W. Lloyd, Dr. Sydney H. Long (Acting Hon. Sec), Prof. F. W. Oliver, Mr. Sam Peel, Dr. E. J. Salisbury, and Miss M. A. Sewell.

V.

OOLOGY AS AN AID TO SCIENCE

By E. C. Stuart Baker, O.B.E., F.Z.S., F.L.S., M.B.O.U.

I think I told you when I had the honour of addressing you last year that egg collecting is looked upon by most people as a silly vice, generally shown either in the very young or the very old. Protectionists look upon it as the acme of all that is cruel, whilst I am afraid even among scientists there are a great many, at the present day, who look upon oology as useless. I tried last year to show you that scientific collecting and the scientific study of eggs may be really of some value. I then briefly referred to many ways, some obvious and some not so easy to follow, in which oology may be of value to ornithology if properly pursued. To-day, I intend to try to show how eggs may help in the study of evolution, which is, of course, a far grander and far bigger thing that any one special branch of Zoology. For this purpose I have brought with me some exhibits which are probably more convincing than slides. It is rather a habit nowadays to decry Darwinism and to assert that modern scientists have shown that Darwin's crude ideas of environmental evolution are exploded. The more, however, I read the works of modern scientists, the more it seems to me that their theories are controlled by Darwin's "survival of the fittest." The great discoveries of Mendel, Bateson and others, important as they are and true as they are, still appear to me to be merely individual factors in the determination of living individuals. A very simple instance of this is Mendel's mathematical progression in the number of forms evolved by crossing. Uncontrolled by other forces his discoveries would merely result that at the end of a given number of years we should have a given number of individuals of each of the variations caused by hybridisation. This, we know, is not the case and we are aware that while certains forms continue and flourish, other forms dwindle away and finally cease to exist, whilst the cause of their variation in continuity in numbers can only be due to their environment. Except, however, in the case of man-controlled hybridisation it is difficult to see Evolution proceed-

ing before our eyes. Compared with the process of environmental selection, man's life is so brief that it is practically impossible to appreciate the changes which are slowly but surely taking place. It does, however, seem to me that Birds' eggs do show us in a very plain manner how the gradual process of evolution is taking place by the destruction or elimination of that which is unsuited to its surroundings. In the form, colour, size and texture of eggs we are constantly meeting facts the reasons for which seem to be fairly simple and obviously due to adaptation to their surroundings, but amongst Cuckoos' eggs we have examples of what, to me at all events, appears to be the most easily read example of the progress of evolution by selection.

The Cuckoo, as we all know, is a bird which is parasitic on others, either laying or depositing its eggs in other birds' nests and taking no part in their incubation or in the bringing up of the young when hatched. It would seem manifest, therefore, that the foster parent upon whom this duty devolves should not be able to distinguish between her own eggs and those of the Cuckoo, otherwise the eggs would not be hatched, the young Cuckoo would not be reared and the Cuckoos which are parasitic would soon become extinct. If the parent bird is to be deceived, then the deception must be carried out by evolution of the Cuckoo's egg, until it becomes sufficiently like that of its foster parent to ensure its being hatched.

Admittedly during most birds' normal breeding life there are three dominant passions or, as I should call them " furores." First, the desire to lay the egg ; secondly, the furore of incubation and thirdly that.of feeding the young, and we know that during these three stages birds react to very curious stimuli and perform very curious actions, though these actions are those of individuals and not of the species. It is quite true that one gets an occasional bird which will sit continually on a marble or a lump of clay, or even on a tennis ball, but such birds are the exception and, if our cuckoo relied on these abnormal birds for bringing up its young, it would meet with many bitter disappointments.

Let us see then if we can show whether the Cuckoo's egg does in any fashion agree with that of its fosterer and, if so, how this assimilation is carried out.

Before proceeding further with my attempt to prove the existence of environmental evolution I should perhaps refer to one other point. I have often been told, when giving my views on the Evolution of Cuckoos' eggs, that I have never proved that there was any necessity for such evolution and that consequently my deductions were groundless. I have therefore to-day brought down a box containing a small series of the eggs of the Indian form of the Common Cuckoo. The largest of this series numbers eleven and they range down to that of two only. In the first series five eggs are shown together with the Pipit's eggs with which they were placed. Of these, two nests were deserted, in one case the Cuckoo's egg having been pecked before desertion. In the next series of seven eggs, six were found in the nests of the Verditer Fly-Catcher and one in that of the Plumbeous Redstart; two eggs were deserted. In the next little series of two eggs only, rather remarkable eggs in colour and size, both were deserted. In the next series of eleven, three were deserted. In the fifth series of seven clutches of eggs the nest containing three Cuckoos was deserted, whilst in the final series of five eggs one was deserted.

In giving the number of nests deserted I have only counted those which were obviously left for good and all, but it is quite possible that some of the others had already been deserted or would have been deserted later, although with the exception of the little series of two, these eggs were all deposited in the nests of normal fosterers having eggs with which the Cuckoos' eggs agreed well. It must be remembered that in many cases it is impossible to say whether eggs have been deserted or not. If one finds the Cuckoo's egg very shortly after it has been placed in the nest, the foster parent has had no time to decide whether it shall desert or not, for it is already known from observation that some birds will sit for a short time on the Cuckoo's egg before they desert. Still I think these series prove that desertion does take place very frequently, whilst it is probable that it is even more frequent than has been actually proved. The *sequitur* is that there is a definite reason for the evolution of the Cuckoo's egg.

Again in many instances, especially in the tropics, eggs do not get cold when unbrooded so that it is no use feeling them to see if they have been recently sat on.

As the result of more than forty-five years' study of Cuckoos' eggs it seems to me that we have certain stages of adaption. First, we have the incipient; second, we have the advanced; and, third, the perfected. I should explain that I use the term "perfected" for those eggs which have arrived at a stage of adaptation which is so advanced that no further progress is necessary, although this stage differs greatly in different species and genera of *Cuculidæ*. As examples of what I have been saying I will commence with our British Cuckoo. I must, however, preface my remarks by saying that I have had to cut down my exhibit to something which should be portable and I therefore confine myself to commenting on what I can actually show you. The English Cuckoo may be said to have five dominant fosterers in England; the Pied Wagtail, the Pipit, the Reed-Warbler, the Robin and the Hedge-Sparrow. Now if we examine the four boxes which I have brought down containing series of eggs of the Cuckoo together with those of the foster parents, but omitting the Robin from the above five, you will see that in all four the type of egg which the Cuckoo lays does not vary very greatly and that it is, on the whole, an egg which does not contrast at all violently with those of the first three, the Wagtail, Pipit, and Warbler but, which does contrast very violently with those of the Hedge-Sparrow. If again we examine the eggs more closely we find that though there is a rough general *likeness* there is also a rough general *difference* between the eggs of the Cuckoos in these boxes. Those eggs which have been deposited in the Wagtails' nests are undoubtedly paler on the whole than those which have been placed in the nests of the Pipits and Warblers, whilst those placed in the Pipits' nests are somewhat darker and often redder than those which have been found in the Warblers' nests. So then it seems that whilst there has been a general adaptation of the Cuckoo's egg which renders it inconspicuous when laid in any one of these birds' nests, there has yet been a further adaptation specially to suit each one of the three genera concerned. This we may call a stage of slightly advanced adaptation. When we come, however, to the Hedge-Sparrow's eggs, we find the difference between Cuckoos' and fosterers' eggs is so great that it seems impossible the foster parent could ever be deceived and it

certainly looks as if evolution was non-existent. Even here, again, a closer examination of the Hedge-Sparrow series of eggs will show that the five eggs in the bottom row of the box do show that some evolution is apparently in progress, for the Cuckoo's eggs are almost uniform pale bluish grey, the markings being infinitely less conspicuous than they are in most Cuckoo's eggs. Perhaps here we have a case of incipient adaptation. My audience will of course ask me why there should be a difference in evolution in eggs of the same bird in the same country. To me there appears to be a fairly simple answer. It is probable that when the Cuckoo first arrived in England the fosterers she imposed upon were the Wagtails, Pipits and Warblers and, in the course of many thousands of years, evolution reached its present stage ; on the other hand the birds increased in numbers so greatly that the supply of original foster parents was insufficient and so she had to seek others. The Hedge-Sparrow, being a very common bird, was one of those selected, but the selection took place at a comparatively recent date and so there has been no time for great developments. In support of this the exhibit in the next two boxes seems to have great weight. In Finland three of the most common types of fosterers are birds of the genera *Phœnicurus*, *Saxicola* and *Oenanthe*, all of which lay blue eggs. You will see from the exhibit that the Cuckoo's egg deposited in these birds' nests is also blue and in one clutch of eggs exhibited you will see two Cuckoos' eggs, one very pale and one dark blue. This shews that Cuckoos' eggs have been evolved of exactly the same range and types of colouring as the eggs of the foster parents, resulting in a certain proportion being anually deposited in the nests of birds which could not possibly distinguish between their own and the Cuckoo's egg. In the next box we have eggs of the Brambling type, such as are normally deposited in the nest of that bird, and you will see by the exhibit that the adaptation here also is almost perfect.

A very beautiful example of environmental evolution is I think shown in the box containing eggs of the little Rufous-bellied Cuckoo. (*Cacomantes merulinus et sub sp.*) Here I show thirty-six eggs deposited in the nests of small Warblers of the genera *Suya*, *Orthotomus* and *Franklinia*. Now these little

birds lay eggs which I may describe as polymorphic in colouration. The ground colour varies from white to pale blue or, less often, very pale pink, whilst they are generally spotted in various degrees with light and dark red in greatly varying manner. The Cuckoos' eggs, as you will see, are also polymorphic in colour so that a certain percentage, sufficient for the continuation of the species, agrees with those of the fosterer, whilst others contrast slightly or decidedly. Now this little Cuckoo has an immense range of breeding area, practically over the whole of the Southern Oriental region and, over the whole of this region, with one exception, it lays eggs of the kind described. The one small exception, however, is an area of some twenty miles in length and breadth round about Hyderabad in the Deccan Province of Southern India. Here for some reason the Cuckoo *invariably* deposits its eggs in the nests of the Little Warbler, *Prinia socialis*, a bird which lays brick red eggs. You will see that a Cuckoo's egg has been produced which agrees well with that of the foster parent. Now it seems to me that this red egg could only have been evolved in one way. The area referred to is on the whole very barren and very dry, whereas this Cuckoo certainly prefers damp, well-wooded country. As however, it became more numerous, competition forced it gradually to spread into a dryer area, in which the Little Warbler, *Prinia*, with the red eggs, is much the most common of the small birds, indeed, it is so common that there are few gardens in the towns which do not have two or three nesting pairs. Perhaps when the Cuckoos first arrived, there were among them some which laid eggs coloured with a very faint tinge of red and, among these eggs, there must have been some which escaped detection and were hatched and the young reared. Among these some grew to maturity and of course laid eggs similar to those of their parents. Of these some again probably laid eggs of yet a slighty stronger red tint and so the process continued until all those birds had been elminated which laid the original normally coloured egg, only those persisting which laid eggs sufficiently red to escape detection.

An extraordinary proof of this occurred in 1928. Two men, both keen field observers, who were not ornithologists in the scientific sense of the word, wrote two letters to a certain

journal. The first of these wrote and asked if anybody could explain how it was that the little *Prinias* which laid red eggs, seemed to have been wiped out all round about the Hyderabad Deccan. The second wrote to say that he had found numerous small Cuckoos' eggs in the nests of Warblers of the *Orthotomus* and *Prinia inornata* groups, the Cuckoo's egg being in each case bright red and nothing like those of the fosterer and, he added "in every single case the nest had been deserted." Here then we have cause and effect shown in a rather startling manner. No doubt our grandchildren will find no red eggs of this Cuckoo ever laid unless *Prinia socialis* recovers its status in the Hyderabad Deccan, for the Cuckoos to cucold.

Passing now from incipient and advanced stages of evolution, I will turn to that condition I term "perfected adaption," though even in this, as I have already remarked, you will see the degree of perfection varies to some extent. The first eggs I show you are those of the Large Hawk Cuckoo (*Hierococcyx sparveoides*), a bird which is much larger than the English Cuckoo although the difference in size in the eggs of the two birds is not very great. This bird lays two kinds of eggs, the first olive-brown, the second blue. The first is deposited in the nests of the Great Spider Hunter (*Arachnothera magna*) or in that of one of the little Short-winged Thrushes (*Drymochares nipalerisis*), and the second type is placed in the nests of the *Garrulax* group of Laughing Thrushes. There is no inter-gradation of any kind between the two forms and each agrees beautifully with the eggs of the birds in the nests of which it is placed, whilst in this instance you also have, what is most exceptional in Cuckoos' eggs, a variation in size as well as in colour. This is what I consider a good example of perfect dimorphic adaptation.

An equally beautiful example of dimorphic, yet perfect, evolution is shown in the eggs of the Small Himalayan Cuckoo (*Cuculus poliocephalus*). This little bird, without undergoing any geographical variation, has the widest range of any of the many species of Cuckoo. It extends from the extreme Western Himalayas to Japan and throughout this vast extent of country shows no subspecific change. This Cuckoo lays two very different types of eggs. In the extreme East, that is to say, in Eastern China and Japan, it lays eggs of a brilliant terra-

cotta red, whereas in the extreme West, that is to say, in the Western Himalayas, it lays pure white eggs. In both these particular areas the eggs are absolutely constant and they are laid—the first, in the nests of *Cettia*, and the second, in the nests of different species of *Phylloscopus*, both of which lay eggs in colour exactly like those of the Cuckoo. As the Eastern form approaches India, *Cettia* is no longer to be found and we find the eggs are deposited in the nests of birds of the *Horornis* group. So far the eggs of the Cuckoos and of the fosterers agree absolutely in colour, only varying in size, shape and texture. When, however, we come to the middle Himalayas, say from Assam to Garhwal, we find that, though the two types of eggs still remain unchanged, there is a great deal of wrong deposition, so that frequently we find red eggs placed in the nests of birds which lay eggs nothing like those of the Cuckoo. This seems to be a case where the Cuckoo has probably extended from one of the extreme ends of its present habitat and that, whilst the intermediate portion is not so suitable to the bird, the two extremities are much more so. In consequence you have a Cuckoo which is very common in both the East and the West, in each of which areas it produces an egg completely adapted to its environment. On the other hand, in the centre portion of its range the bird is much less common and is probably only kept going by a constant irruption from the East and West areas of birds which are of a strain laying a finally adapted egg. Quite possibly in course of time we may have the bird in the central portion completely eliminated and, eventually, geographical and other conditions may cause changes in the birds, thus sufficing to distinguish them as subspecies or even species.

Another form of perfect adaptation is that in which evolution has eliminated all but one type of egg, excellent examples of which are the Crested Hawk Cuckoo (*Clamator corromandus*) and the Koel (*Eudynamis scolopacea*). Of these two the former is undoubtedly the more perfect. It invariably lays a very spherical pale blue egg, varying very little indeed in depth of colour or in other respects. It is equally invariably laid in the nests of either *Garrulax moniliger* or *G. pectoralis*, both of which lay eggs of the same colour, though different in shape. The evolution of an egg to a state of perfection such as this

depends on a good many factors. In the first place the bird itself must have a definite breeding area. In the second place the selected fosterers must be extremely common within that area, so that their nests are easy to find. Thirdly, the fosterers must be such as are suitable in every way to rear the young Cuckoo when hatched. All these factors obtain in regard to this Cuckoo and the selected foster parents. It may be said that under circumstances such as these the Cuckoo would soon become so common that all the nests of the foster parents would be made use of and so, by degrees, the foster parents would thus be wiped out of existence, having had to spend the whole of their time and energy in incubating and rearing young Cuckoos to the exclusion of their own. The very perfection of the adaptation in this Cuckoo's egg does away with this result, for the eggs are so extremely like those of the fosterer that not only is the foster parent deceived but the Cuckoo herself and, in consequence, one or several Cuckoos often place two or several eggs in the same nest instead of hunting for another in which no Cuckoo's egg has been previously deposited. In the series shown you to-night, you may see two clutches of eggs containing 6 Cuckoos' eggs in addition to those of the fosterer. Now in both these cases the final result will be the bringing up of one young Cuckoo by one pair of Laughing Thrushes instead of six pairs of Laughing Thrushes having to look after six young Cuckoos, so the remaining five of the former may have a chance of looking after their own young.

The other series I show you is very similar in results, although the eggs are so different. The Koel, as you are aware, is parasitic almost entirely on birds of the genus *Corvus* and wherever a Koel is to be found, Crows of some kind are common. There are only two exceptions that I know of and in these two cases the Koels have adopted as fosterers Magpies in Western China and the Shan States and certain large Starlings (*Gracaulipica niguicollis*) in parts of South-Western China. In both these cases the area is of a comparatively small extent. In India and in many parts of Burma, the Koel is undoubtedly the most common of all Cuckoos but its selected fosterer, the House Crow, is even more common. In this series you will see the same set of conditions obtaining as in that of the Crested Cuckoo whilst there are also examples of large numbers

of Cuckoos' eggs being deposited in the same nest. In the series itself there is one set of nine eggs and I have heard of sixteen Cuckoos' eggs being found in one Crow's nest.

My final exhibit is a box containing a few eggs of the Pied Cuckoo (*Clamator jacobinus*). This bird places its dark blue eggs in the nests of birds of the genera *Argya* and *Turdoides* and I think you will agree with me that it is very difficult even for human beings to say which are the Cuckoos' eggs and which are those of the foster parent, for here we have not only an exact adaptation in colour but also in size, shape and superficial texture. Indeed, so close is the resemblance that I have myself taken eggs which I did not distinguish to be Cuckoos' until I had taken them home and begun to blow them. The thick shell, pale yellow yolk and great comparative weight of the egg then showed of course, that they were unmistakably those of a Cuckoo.

I have already said how I think the process of evolution goes on but, to sum up, we may describe it as follows. Among the eggs of parasitic Cuckoos of every kind there is a certain degree of variation, coming under Darwin's definition of "individual variation." Among the fosterers, on the other hand, there is a certain percentage of birds who have sufficient intelligence to distinguish between their own eggs and other eggs which contrast very strongly with them. In consequence those eggs which agree least well with those of the fosterers are rejected in greater proportion than those which are more like the eggs of the birds which are asked to adopt them. In this way we get a constant elimination of the most unfit, until in the process of time an egg is evolved which, even if it is not exactly like that of the foster parent, is sufficiently so to ensure its being accepted, hatched and the young reared. This seems to me to be an excellent proof of Darwin's theory of the "Survival of the Fittest."

VI.

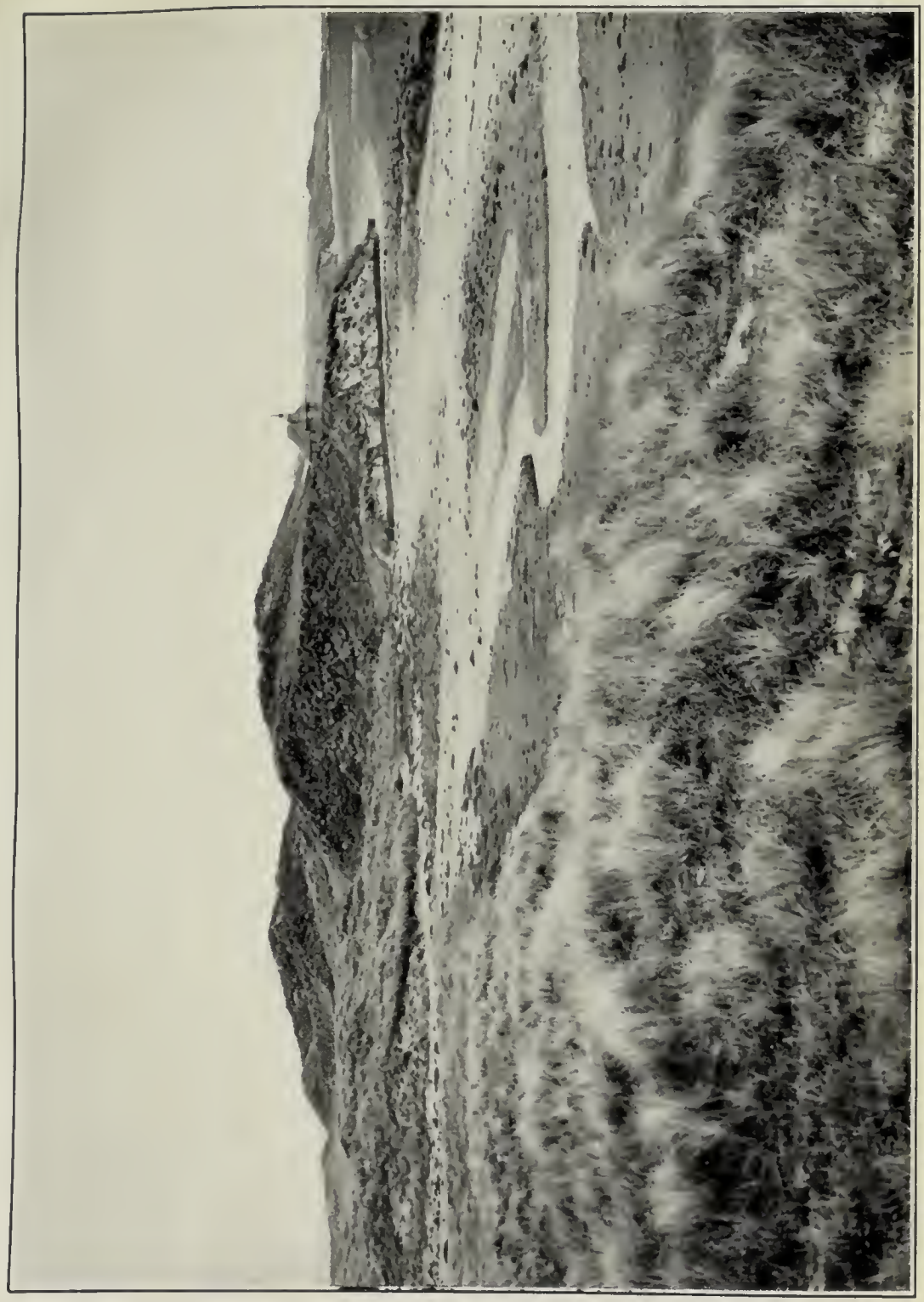
GEOGRAPHICAL WORK ON SCOLT HEAD ISLAND AND ADJACENT AREAS

By J. A. Steers, M.A.

During the past few years a certain number of papers on Geographical aspects of Scolt Head Island have appeared in these Transactions. These papers have been of a general nature and serve as a basis for future work. In order to accomplish such work it seems advisable that the island problems should be approached from a wider point of view, and that more trained people should be encouraged to take an interest in them. Hence steps were taken to bring the Cambridge University School of Geography into touch with the Committee of the Norfolk and Norwich Naturalists' Society with a view to affording students easy access to Scolt Head Island to carry out practical work which will be at once valuable in certain aspects of the training of Geographers, and also in the gradual accumulation of data for a memoir on the island.

To accomplished this end one of the first necessities was the foundation of a laboratory near at hand and suitable for use in connection with field-work. This has been made possible in two ways. First, the Norfolk Naturalists Trust has purchased "Dial House" in Brancaster Staithe for the watcher, Mr. Charles Chestney. This house contains ample accommodation for visitors interested in the island, and also extensive outbuildings. Second, the University of Cambridge placed a certain sum of money at the disposal of the Cambridge Geography School which enabled the latter to make various structural alterations in one of the outhouses, the old Brew House, so as to adapt it as a field-laboratory in which its students can work.

The full equipment of this laboratory cannot be found for some time; the limitation of finances and the development of a suitable technique for dealing with island problems both render a gradual increase in scientific apparatus necessary. Nevertheless, a beginning has been made and in time a field station, similar to Dr. F. W. Oliver's at Blakeney Point, should be available.



THE HUT HILLS, SCOLT HEAD ISLAND

Photo] *[J. A. Steers*

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It may be of interest to readers of these Transactions to indicate a few of the Geographical problems to which attention may be devoted. Necessarily they will overlap a good deal on to other sciences ; hence the co-operation of workers in the biological sciences will be welcomed.

The erection of a self-recording tide-gauge is important. The establishment of a mean sea level to which all surveying work can be referred is an essential. Unfortunately the cost of such an instrument is rather high, and so its erection will have to be postponed for a time. The whole matter of tidal currents off the main beach and in Norton Creek needs careful investigation. The general set of such currents is known, but their details are not. Further, the velocities and transporting powers of these currents require investigation with particular reference to their constructive and other effects on sand and shingle bars, and also with regard to the amount of silt carried through the harbour mouths at Overy Staithe and at Brancaster.

Silt deposition on the marshes is another big problem. So far very little has been done in this way. The problem is intimately bound up with the spread of marsh vegetation and a full analysis of the conditions of sedimentation implies a knowledge of physical-chemistry. A careful collection of the sediments must also be made and analysed. Whilst this is being done, it would be useful to make a " geological " survey of the island. The surface distribution of sand, shingle and mud is obvious, but vertical sections of bores would help much in making clear the whole structure of the island. A systematic series of bores put down to a depth of five or six feet—more in places—would probably give the data sufficient for such a survey. Careful analyses of the bore sections should also be made.

A large and more difficult problem is that of making a contoured map of the island, especially of the marshes. The differences of level are very small and, except for lines of levels, the usual surveying methods are of small use. Probably the best way of meeting the difficulty is by photographic-survey. In any particular marsh, such as that in front of the Hut, plates taken with a photo-theodolite at regular time intervals during the rise of a high spring tide would afford data from which a contoured map could be made. This

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7. Determination of the Water Table.
8. Meteorological Measurements.
9. Rates of Dune growth and related problems.

If carried out carefully such work will give not only very interesting general results of scientific value, but will also make possible the production of a geographical memoir of considerable interest on Scolt Head Island.

As the Geographical Laboratory will be on the mainland, the Hut will not be affected, and Ornithologists and others who visit the island will not find their work impeded in any way. It cannot be emphasized too much that all scientific work relating to the island must be developed. The schemes outlined above in no way interfere with the present interests in Scolt Head, and bird-lovers and others will not find their work interrupted.

VII.

MUSEUM BOULTERIANUM

By Charles Davies Sherborn

In the Transactions of this Society (VI. [1] 1895, p. 81) appeared a brief note by Mr. F. D. Palmer on Daniel Boulter of Yarmouth who died in 1802. Little is there said but that he was a Quaker, dealt in general goods, and had a Museum. It may be therefore of interest to note that I have lately come into the possession of a copy of his Museum Catalogue, and it will be useful to put the following notes on record.

The book has no printed wrapper but on the half-title is a sort of Trade-card which reads ;—

DANIEL BOULTER, / No. 19, Market-Place, Yarmouth, / Sells, wholesale and retail, great choice of the best London made, Birming- / ham, Wolverhampton, Sheffield, and Pontipool Goods, in the newest taste, se- / lected from the principal manufactories, in the Silversmith, Jewellery, Cutlery / and Toy Line. Also a great variety of Books of all kinds, new and second-hand, / Stationary Wares, Haberdashery, Gloves, Perfumery, & Patent Medecines. / N.B. The full value given for light gold, foreign coin, silver, jewells, watches, &c. /

whether purchased or taken in exchange.——Mourning, motto, and hair-device / rings, lockets, &c. with every other article in the jewellery branch, executed / with elegance and expedi tion.——All kinds of jewellery, watches, and silver / goods, neatly repaired or engraved. / ***His museum, which has been upwards of twenty years in collecting, is / daily open for the inspection of the curious.——Admittance by ticket / or one shilling each person. / Natural Curiosities, Antiquities, Coins. Medals, / CURIOUS BOOKS, &c. / Bought, sold, or exchanged. /

The Title-page reads ;—

MUSEUM BOULTERIANUM [in Gothic type] / A / CATALOGUE / of the / curious and valuable collection / of / natural and artificial curiosities / in the / extensive Museum / of / Daniel Boulter, Yarmouth : / consisting of / English and Foreign Birds and Beasts in high Preservation. Reptiles, / Fish, and Insects, dried and in Spirits. Elegant Shells, Corals, / Corallines, and other Marine Productions. Seeds, Fruits, and / other parts of rare plants. Fine Specimens of different Ores, / Petrefactions, Spars, Fluors, and Crystals. Agates, Calcedonies / Jaspers, Carnelians, &c. polished and unpolished. Roman, Egyp- / tian, and British Antiquities in Earthen Ware and Bronze. Carvings / in Wood, Stone, Ivory, and Alabaster. Curious ancient Enamel- / lings, China and Delft. Shell-Work, Needle-Work, &c. Cruci- / fixes and Rosaries. Ancient Stained Glass. Parts of Dresses, / Utensils, &c. Ancient Weapons of War. Old Monastic and / other Seals. Watches, Rings, and Amulets. Greek, Roman, / Egyptian, British, and English Coins and Medals, in Gold, Silver, / and Copper. Dresses, Ornaments, Weapons of War, Fishing- / Tackle, and other singular Inventions of the Natives of the lately / discovered Islands in the South-Seas.* Some capital Paintings by / the first Masters. Rare old Prints, including a large Collection / of Engraved Portraits, with a select Library of curious and / valuable Books in Natural History, Antiquities, &c. &c. Some / curious Missals, and a great Number of other singular Articles both / Ancient and Modern. [two rules] Price One Shilling. / To be had of

* Query James Cook's Voyages 1768-1780.

Henry Gardner, No. 200, Strand ; B. & J. White, / Fleet-Street; Darton and Harvey, No. 55, Gracechurch-Street; John / Simcoe, No. 11, Great Queen-street ; London. Yarrington and / Bacon, and R. Beatniffe, Norwich. And other Booksellers in / Town or Country. / N.B. Purchasers to the Amount of Ten Shillings will have the Price / of the Catalogue returned. /

Then follow (p.iii) Advertisement, (iv) Abbreviations explained [all of Titles of Books] (v, vi) Index (vii) errata, (viii) blank, (1-165) the Catalogue, (166) blank, (167) List of Donors [among which occur 6 Boulters, Sir Ashton Lever, 3 Sparshalls, Lilly Wigg, and other interesting people].

The Catalogue is remarkable for having printed prices affixed to each item and this seems to point to a late date when Boulter possibly wished to realize on his Collection. He is careful to note in his Advertisement that " Donations " are " excepted " from these prices. The only date found is " 1794 " pencilled on the Title-page, altered to " 1793."

Of the articles catalogued the Prints number over 800 and the Books 984, a remarkable collection, the prices of which makes one's mouth water.

This rare little volume will be preserved in the British Museum (Natural History) where it can be seen by anyone interested.

VIII.
THE GREAT YARMOUTH AUTUMN HERRING FISHERY
1928

By The Editor

The success of the Yarmouth herring fishing depends, in the last analysis, upon the capacity of the European peasant to consume salted herrings during the winter. It is not a question of organising a fleet and equipping it to catch herrings, but entirely a matter of marketing the catch, for 95 per cent. of the fish landed has to find a foreign destination. It may be quite true that herrings represent the cheapest food product available in north-west and central Europe, but the demand is rigidly limited, and the big concerns on the other side of the North Sea, who handle the business on its distributing side,

know to a barrel how many the various countries can absorb in a season. One great outlet is closed through private trading with Russia being rendered an impossibility, though countries whose frontiers march with the Soviet borders may be able to carry on business to some extent with the Republic. It is probable that the war wastage has not yet been made good among the consuming populations, while their financial resources have been greatly reduced, and even their tastes may have changed.

A comparatively new feature, too, is the export of fresh herrings to Germany, and it would seem only natural that, as this business develops, export of the cured herring may suffer some decline. It has also to be remembered that fierce competition goes on with Norway and Holland, which seek the same markets as we are after, and Germany is doing everything possible to increase its own catching power. The ordinary inhabitant probably has no conception of the competition which the Yarmouth herring has to face abroad. To the same foreign ports to which our shipments go are also sent cargoes from Ireland, Scotland, North-Eastern England, and Iceland, to say nothing of Norway and Holland. At Riga, for example, Yarmouth herrings have to be sold side by side with cargoes from Lerwick, Wick, Stornoway, North Shields, Fraserburgh, Peterhead and Ardglass, so that the merits of our fish must be convincing. Apart from these inevitable handicaps, the fishing this season has suffered from its own success, paradoxical as that may sound, for two many herrings were caught in too short a time. Sometimes a crop is so big as to be almost profitless to the farmer, and the herring crop was harvested in such plenty that for the first time in living recollection the curers met and decided they must stop, or they would flood the markets, send down prices, incur losses and throw the trade into confusion if not chaos. This drastic step was brought about through continuous fine fishing weather, large daily hauls and herrings being of the best quality. So the bulk of the Scotch fleet went home earlier than usual, but some lingered on and, with the smaller landings, higher prices ruled, so that most of the boats made a good finish.

The best Yarmouth drifter is reputed to have grossed over £3,000, and a few reached £2,000, but the general run would

be between £1,500 and £1,800. Taking it in all its aspects this herring fishing from Yarmouth is a business of no little magnitude, for the season's catch, which was an immense advance on that of last year, represents a value at first hand of anything between £750,000 and £1,000,000. The landings to December 8th were 520,177 crans compared with 405,490 crans in 1927, and 393,068 crans in 1926. The better to understand these figures it may be stated that a cran of herrings is approximately 1,000 fish, so that the total number of herrings landed at Yarmouth during the four months—August to November—of 1928, was about 480 millions. We set out below the deliveries during the busy part of the season :—

Week ending	1928. Crans.	1927. Crans.	1926. Crans.
Oct. 6	53,554	34,242	11,920
,, 13	31,867	97,321	44,872
,, 20	89,518	40,578	143,784
,, 27	107,773	63,076	52,727
Nov. 3	124,694	52,367	45,999
,, 10	52,850	66,863	43,829
,, 17	18,855	18,771	19,688
,, 24	5,966	1,329	8,007
Dec. 1	5,765	6,337	3,766
,, 8	4,531	3,715	2,196

The density of the shoals and the abundance of herrings has been proved by some remarkable hauls. On September 15th the Lowestoft drifter Two Boys brought in 195 crans and handed over the balance of her nets to three other drifters, which took out 97 crans, 90, and 55 crans respectively, giving the total of 437 crans for one "strike."

October saw the peak point of the fishing, and the catch of the season was made on October 26th, when 569 boats landed 44,831 crans, showing the high average of 78 crans. Shots of from 180 to 100 crans were frequent, and despite the rush of boats there was no congestion in the Harbour, no confusion, and no undue delay.

The fleet comprised 623 Scotch boats, 112 Yarmouth boats, and 13 boats from other ports, a total of 748, compared with 784 last year and 833 in 1926.

Scotch curers numbered 103, compared with 112 last year

and 117 in 1926. Fish workers from the North totalled 3,357 against 3,456 last year and 3,420 in 1926. Scotch coopers, carters and labourers were employed to the number of 804, as against 810 last year and 780 in 1926. The first fish workers' special train arrived from Aberdeen on September 25th, and on October 5th and 6th fourteen specials brought an invasion of nearly 3,000 Highland lassies to work over the herring troughs.

It is of interest to note where Yarmouth herrings go, for they cover an almost world wide territory. So far to Danzig, the corridor port for North Western Europe, have been sent this season 109,738 barrels, nearly twelve thousand more than last year, 37,618 barrels to Stettin, 37,618 barrels against 39,045 to Libau, 31,698 against 29,614 to Konisberg, 28,091 against 18,667 to Riga, 16,308 against 14,471, Duisberg 6426 against 5651, Hamburg 5179 against 3976, Memel 3075 against 4027, Wyburg 2661 against 902. These are the usual centres, but there are some others. The Holy Land has taken 782 barrels through Haifa, and 282 through Jaffa. Montreal has received 150 barrels, and the United States took 1036 barrels divided between New York, Boston, Philadelphia and Baltimore, and to all these points none had been shipped last year. Australia also has a sample, 12 barrels being shipped to Melbourne. Belgium took 250 barrels at Bruges, and Holland received 100 barrels at Vlaardingen and 1637 at Ymuiden. Even London took 176 barrels. The Yarmouth cure this year totalled 457,310 barrels, of which so far 250,250 have been shipped.

By way of record, it is perhaps interesting to recall that the highest price paid for herrings was £5 10s. per cran on November 17th, obtained by a Berwick boat, in contrast with only 10s. a cran, paid for some inferior salted fish. Of coal for bunkers a large proportion came by sea, and the general rate was around 32s. per ton. Paraffin oil for motor drifters, at 7d. per gallon, was one halfpenny cheaper. The number of boats fitted with wireless receivers showed a considerable increase this season, and when the crews are able to listen-in this must have been a source of great pleasure to them.

The above information has been extracted from the columns of the " Eastern Daily Press," to the Editor of which we tender thanks.

IX.

AFFORESTATION IN BRECKLAND

By Brigadier-General H. G. Joly de Lotbinière, D.S.O.

My early days were spent in Canada, where my family still possess one of the original French Seigniory's, a considerable portion of which is still a primeval forest. For this reason, possibly, I have the same love for trees that you have for your wild birds, and I can understand your anxiety to maintain a portion, at least, of your beautiful Breckland, and that you do not wish to see the whole converted into pine forest.

In my opinion the only tree, if we except the birch, that is at home on the major part of your breck lands is the pine. This species is the lover of dry and sandy soils, as opposed to the firs and spruces which prefer damper conditions both above and below; and to the hard-woods, which prefer stronger and more fertile soils.

It is unfortunate that in this country the birch does not grow into a larger and more valuable tree, as it does in Canada; because with its picturesque white stems it would make an attractive wood, which, with its thin canopy of leaves, would be much more suited to bird life than is the denser, canopied pine. I am assured that, although it will not be planted by the Commission, it will find its own way into the plantations, and I am hopeful that in the future we may, in certain parts, find birch glades amongst the pine woods. None of the spruces or firs, excepting possibly the Douglas, will I think be included in these plantations, but oak, beech, larch and, in places, poplar will be planted.

The present plan is to lay out these forests in blocks of about thirty acres—roughly, in areas of 400 yards each way. These blocks will be bounded by rides as a precautionary measure to localise fires, and also as a convenience when the timber is being moved. The rides or fire lines will be planted on either side with hard-woods, mostly oak and beech, for the width of a chain (twenty-two yards), which will act as an additional protection against fires and help to break the monotony of the dark masses of pine. Also every public road will have its belt of hard-woods. It is estimated that these rides and

belts will comprise about ten per cent. of the forest area. They will also perform another and technical duty which I will touch upon presently. One fifth of the blocks will, I am informed, be composed of beech and larch, a very attractive mixture as the beech is our most beautiful tree, and the larch in spring especially striking. We shall have therefore a variety in the planting, which should go a long way to kill the monotony of an endless, ever-green pine vista. We cannot, however, get away from the fact that the main crop will be pine and will consist of two varieties, the Scotch and Corsican, and I should like to say a few words about these two pines.

The Scotch, as you know, is a tree indigenous to this country, but the Corsican is an exotic from southern Europe. I believe a few Maritime pines have been planted at Rendelsham, but the experiment is not being repeated.

The Scotch pine has the widest distribution of any pine and extends right across the northern part of Europe and Siberia, growing best where the winters are cold and the summers hot. Where grown under forest conditions the timber is excellent and is known commercially as Riga, Dantzig, or Yellow Deal. It is said that the remains of primeval forests still exist in a few places in the Highlands of Scotland. In their early life these exclusive Scotch pine areas will, I fear, be less attractive to look upon than your open breck lands and will give little enjoyment to this generation; but if they are permitted to grow to middle age, say forty years, the next generation will admire their lengthening red boles. However, it will be the following generation, when the trees have reached maturity at about eighty years, which will be able to appreciate their full beauty and enjoy the mystery and solemnity such as one finds in a cathedral of magnificent columns and arched domes.

Wild life will, I am afraid, suffer from lack of food and sun, and I doubt if these forests of the future will hold as much wild life as your breck lands do to-day.

We now come to the Corsican pine, an exotic from the Mediterranean littoral. It is doing extraordinarily well in this country and is being extensively planted in New Zealand and in South Africa, with the object of producing timber as rapidly as possible. In England it is becoming a rival to our Scotch pine, but it is still doubtful if the quality of the timber

will be as good as that of the Scotch, and it is not in such favour for pit-props. Its chief merit is its rapid growth, so that it produces a very heavy crop of timber in a comparatively short time, besides accommodating itself to our soils and climate. From a beauty point of view it cannot compare with the Scotch pine, but an old wood of these trees with their dark grey stems of great height should be a very impressive sight.

I stated that the hard-wood belts would perform a technical duty, besides being ornamental and a safety against the spread of fire. For all practical purposes we may look upon these belts of oak and beech as being permanent, for we know that they can live for hundreds of years. The blocks of pine, on the contrary, will in some cases be cut at an early age for pit-props or pulp-wood, but in others will be allowed to grow to mature timber suitable for building purposes. This course will be necessary in order to sub-divide the forest into different age classes. As an example, in a 25,000-acre area, such as Thetford Chase, the planting is being done at the rate of 2,500 acres a year, so that the whole will be planted in ten years' time. If all the trees were left to grow to the same age before felling, the whole area would be cut down in a period of ten years and there would be no further crop for many years afterwards. Such a system would not be economical in practice, as it is desirable to have a crop every year. Hence the necessity of cutting some of the blocks when only of pit-prop size in order to establish a uniform yearly supply of timber. The ornamental hard-wood belts will remain as wind shelters to the subsequent plantations.

In addition to the drives and roadways there will be a considerable number of fields with cottages in the forest. For every 200 acres there will be a small holding of at least ten acres, with a cottage for a forest worker, or a total of about 130 for the Thetford Chase area. Each forest worker is guaranteed at least 150 days' work in the year. I believe these holdings are much sought after, and they should in time be the homes of a hardy type of worker.

Rabbits are being effectually dealt with and when exterminated the interior wire-netting will be moved, and only that bordering the public roads and boundaries maintained. The Roe Deer, which are in considerable numbers near Brandon,

will probably increase and spread throughout the forest; as it is, they do a certain amount of damage, especially to the larch, which they are particularly fond of.

The public will, no doubt, be admitted into the forest in time, but certain places of interest, such as the Punch Bowl and Fowlmere, will be left unplanted and remain accessible.

In addition to Thetford Chase the Commissioners have acquired and are planting in East Anglia 5000 acres at Rendelsham, 5000 acres at Swaffham, 1000 acres at Melton Constable and 1000 acres at Dunwich. Up to the present 14,000 acres have been planted in the Thetford area.

Having described the work of the Forestry Commissioners in East Anglia I must refer briefly to the necessity for planting in England. During the War a very serious situation arose over the difficulty of maintaining supplies of pit-props to the coal mines. For every hundred tons of coal brought to the surface at least one ton of pit-props is required; and as we raise about 250 million tons of coal annually, we require two and a half million tons of pit-props. These, if laid out end to end, would circle the equator four times.

Our yearly importation of wood of all kinds amounts to sixty million pounds sterling. Further, in proportion to our land surface we have less commercial timber growing in this country than in any other European country, except Portugal.

The arguments in favour of afforestation are strong and may be stated very briefly, as follows.

A reserve of timber both for economic and for industrial reasons, and in case of war, is essential.

There are large areas unsuited for any other crop (rabbits excepted) and, unless planted with timber, will remain derelict. If we are to find work for our ever-increasing population every source of employment must be fully developed.

When I returned from the War I was much impressed by what one of our leading foresters told me. He said that in order to bring the American troops to France it was found necessary to set free four million tons of shipping. This was achieved largely by cutting down our young plantations to supply pit-props to the mines, but it left the country denuded of timber. Broadly speaking the present programme aims at replacing the three millions of acres then felled and, in ad-

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Photo] [*I. S. Thomson*

Male and Female Montagu's Harriers at nest at Hickling, 1929

dition, to afforest a further two million acres, and thus to raise our proportion of woodland from about four per cent, to nearly seven per cent. of the total land area. I hope you all agree with me that we ought not as a nation to be blind to the necessity for afforestation.

I now come to what I think is uppermost in your minds. Where is this afforestation going to end in East Anglia, and are you going to lose all your Breckland as a breeding ground for rare and interesting species? These questions appear to me to point to the necessity for a Society such as yours, and I am sure you can save some, at least, of this unique part of England.

I am not aware of any case where a Government has taken up afforestation and subsequently abandoned it. Afforestation has come to stay and the only brake that will be applied is that of cost. The Forestry Commissioners will not, I think, acquire isolated areas of less than 1000 acres ; the cost of planting and administering smaller areas would be prohibitive. Your opportunity, therefore, lies in the preservation of the small and isolated areas of Breckland. You could make a survey by voluntary workers and mark on the 6-inch Ordnance maps all the areas that are important from your point of view, and who are the owners ; you would then have the necessary data from which you could draw up a programme.

X.

WILD BIRD PROTECTION IN NORFOLK IN 1929

Report of the Committee

By issuing, annually, a report on the measures taken to assist in the protection of wild birds in Norfolk, especially during the nesting season, and of placing on record events of ornithological interest, the committee feels that it is not only paying back a debt to its subscribers, but it is also encouraging the spirit of Protection, which its supporters would wish to see extended.

During the year under review the Home Office has issued a new Wild Birds Protection Order for the county, which repeals all previous Orders, and which, unless rescinded or altered

by a Supplementary Order, will remain in force for the next five years. That this Order may receive added publicity we reproduce it at the end of this report.

With the exception of the watcher on Breydon, those in the service of the Committee remain as last year. A house-boat, purchased last year, has been moored on the ternery on Blakeney Point, and in this Pinchen passed the night throughout the nesting season. The birds very soon learned to disregard it, and from it they could be watched at close quarters. As mentioned on p. 685, a permanent residence, Dial House, has been purchased for the watcher of Scolt Head Island.

One additional note. If subscribers could remember to send their subscriptions on the 1st of January, or, better still, would sign and return the banker's order enclosed with this report they would save our honorary secretary's outward correspondence by from 400 to 500 letters a year.

Breydon

The committee continues to maintain a watcher on Breydon during the summer and, as a successor to William Betts, who resigned, appointed William Bull Death, who was on duty from April 1st to August 31st. It is not an altogether enviable post, as the house-boat which he occupies is moored in the middle of the estuary and is exposed to very stormy weather, and such was experienced during April and May of the past season.

The presence of a watcher on these extensive mud-flats is undoubtedly a deterrent to illicit shooting, especially at the beginning and end of the season, though in these days when the demand for British-killed "specimens" has almost died out, there is no longer the same temptation to shoot every rare bird that puts in an appearance. As usual, Spoonbills paid periodical visits to Breydon this summer, and on June 4th seven arrived, to be joined by another on the 10th. We went over to see these birds, which remained until the 13th.

As bearing on the question of the return route taken by the terns that nest on our foreshores it has been noted for many years that about the middle of July Little Terns begin to appear on Breydon, to be followed in a few days by Common Terns, and on July 23rd of the past season the watcher esti-

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Photo] [*R. M. Garnett*

ROBERT BISHOP

Watcher of the Cley Marshes

mated that there were between one and two thousand Common Terns on the estuary. Sandwich Terns are seen only in small numbers, but on the coast, for example, at Horsey, there is a steady movement of these birds to the south during August and September. The fact that three young Sandwich Terns ringed on Blakeney Point by Mr. A. W. Boyd in 1928 were recovered about six weeks later north of their birth place—one seven miles north of Aberdeen—("British Birds," Vol. XXII, p. 187) suggests that the return route taken by some of the birds is *via* the north and west coasts of Scotland, but the evidence for this is inconclusive.

Cley and Salthouse

As will be known to most of our subscribers, the Cley Marshes, 400 acres, are the property of the Norfolk Naturalists Trust, whereas the marshes on the other side of the East Bank, commonly known as Salthouse Broad, are held by various owners. It is fortunate that these latter are eager to co-operate with the Trust in the protection of the birds during the nesting season, for that is the most important period in the life of a bird when it needs most protection from its enemies. The Broad is really the complement of the marshes, because for certain species, especially waders, the shallow watered flats on the Broad are a rich feeding ground for this class of birds. The marshes, on the other hand, with their extensive reed beds and coarse herbage and numerous shallow lagoons afford more attractive resting places and breeding ground. It thus happens that at any season of the year, but more especially during the spring and autumn migration, the East Bank, at Cley, is one of the best observation posts for the bird watcher. The marshes were acquired and conveyed to the Trust in the hope that, if carefully looked after during the breeding season, certain of our lost species might be induced to return to nest; and although that is but three years ago there are already indications that this hope may some day be fulfilled.

The following notes are compiled from the journal of Mr. Ronald M. Garnett, of Kelling, who visited the marshes almost daily from May to November, and from observations by the writer and by Bishop, the watcher. The dates all refer to the year 1929.

STARLING (*Sturnus vulgaris vulgaris*).—An enormous number of Starlings have recently resorted to reeds on the Cley marshes for roosting. It is impracticable to drive them away.

GOLDFINCH (*Carduelis carduelis britannica*).—Is becoming more common in the district. A flock of about sixty were feeding on thistle seeds on Blakeney Eye on September 21st.

SNOW-BUNTING (*Plectrophenax nivalis*).—During the past winter were unsually numerous, in flocks of 200—300. First arrivals October 15th.

YELLOW WAGTAIL (*Motacilla flava rayi*).—For the past year or so has decreased in numbers. One seen on the East Bank on April 18th, and one nest found, the young of which were ringed on June 23rd.

RED-BACKED SHRIKE (*Lanius collurio collurio*).—For several years past a pair has nested near the Watcher's hut. This year six young were hatched, which were ringed.

PIED FLYCATCHER (*Muscicapa hypoleuca hypoleuca*).—Not so numerous this year as in most autumns. First seen on September 5th.

BARRED WARBLER (*Sylvia nisoria nisoria*).—One seen near the Watch-house on September 5th by R. M. G., A. Holte Macpherson and others.

FIELDFARE (*Turdus pilaris*).—An early arrival flushed from the bushes on September 17th. Small parties coming in from the sea on October 10th.

COMMON BUZZARD (*Buteo buteo buteo*).—One seen crossing the Cley marshes on an inland course on April 19th.

PEREGRINE FALCON (*Falco peregrinus peregrinus*).—One over Salthouse Broad on September 8th and 9th, another on the 27th and one on October 16th, during a rush of migrants.

MERLIN (*Falco columbarius æsalon*).—One was seen on Blakeney Point on September 17th.

MARSH-HARRIER (*Circus æruginosus*).—On May 16th one was seen circling over Kelling Hangs and, turning its head, gave a good view of the buff crown and nape.

SPOONBILL (*Platalea leucorodia leucorodia*).—The visits of this bird are becoming more frequent, and during the past summer many had the pleasure of watching it feeding on one or other side of the East Bank. On March 22nd one was seen flying high to the south by E. Ramm, and five days later one

was feeding on the Salthouse marshes (Bishop). On June 4th there were four on the Cley marshes. The last bird left on September 14th.

Barnacle Goose (*Branta leucopsis*).—Wild geese of any species are rarely to be found on either the Cley or Salthouse marshes, though passing skeins are frequently to be seen. The Barnacle is an uncommon visitor to Norfolk, so that it is worth recording that two were found resting near the East Bank on October 31st (S. H. L.) After a short time they flew out to sea.

Common Pochard (*Nyroca ferina ferina*).—Has occasionally nested on the Cley marshes (Pashley). A pair was seen on the marshes on June 9th, and a male on the other side of the bank on the 16th, but there is no evidence of nesting.

Red-necked Phalarope (*Phalaropus lobatus*).—An adult in winter plumage, a very confiding bird, was seen daily feeding on a pool on the Cley marshes from October 19th to the 21st.

Wood Sandpiper (*Tringa glareola*).—Among the many Green Sandpipers that are to be found in the pools amongst the thick herbage on the Cley marshes in autumn it is not easy to identify a closely-allied species, but on August 31st the writer and R. M. G. had a good view of two of these birds, which eventually took to wing, uttering their characteristic call.

Greenshank (*Tringa nebularia*).—During the past season was more numerous than usual. The first was seen on July 21st, and there were two on the marshes as late as October 16th.

Black-tailed Godwit (*Limosa limosa limosa*).—Two were seen on Salthouse Broad on August 20th, and there were three on the Cley marshes on October 5th. Another was seen and heard on November 12th.

Avocet (*Recurvirostra avocetta*).—From June 9th to July 1st an avocet was to be seen daily feeding on Salthouse Broad. This fact soon became known amongst bird lovers, and a large numbers of visitors went to see it. Another appeared on September 11th and was joined by a second two days later. One of these disappeared and the other remained until October 12th, when it was seen to rise to a considerable height and go off to the westward with seven Sheld-ducks.

Black Tern (*Chlidonias niger niger*).—About the usual number of this species was passing through during the spring and autumn.

Common Tern (*Sterna hirundo hirundo*).—This species is being gradually displaced by the Sandwich Tern on Salthouse Broad. There were from 50—100 nests this year.

Sandwich Tern (*Sterna sandvicensis sandvicensis*).—On two small islands on Salthouse Broad, within good view of the East Bank, there was again this year a very closely-packed colony of these birds. During the last week in May the keeper (Holman) counted 271 nests. On July 1st R. M. G. ringed 189, and there were then about sixty too active to be caught.

Mr. Robert Bishop, of Cley, continues to act as the watcher of the Cley marshes, and has now the added pleasure of watching his birds through a pair of prismatic field-glasses kindly presented to the Norfolk Naturalists Trust by Lt.-Col. R. M. Byne.

Blakeney Point

The chief interest of Blakeney Point during the breeding season is the very large colony of Terns that now nest here. During the past season the number of birds was quite up to that of last year, at any rate as regards the Sandwich Terns. On June 4th 1,008 eggs of these birds were counted ; 302 twos, 2 threes, the rest being singles. Many eggs were laid after this date so that 1,000 pairs of Sandwich Terns nesting in this colony during 1929 would be a conservative estimate. In addition, there were several hundred nests of the Common Tern. These latter now nest on the Far Point in the company of the Sandwich Tern, and there were very few nests this year on the dunes to the north of the old Life-boat House. It is commonly supposed that the Roseate Tern arrives about a month later than the other Terns, but this is not the experience at Blakeney. This year the first Common Tern was seen on April 30th and on May 16th the first Roseate was seen. On May 25th a Roseate's nest was found containing one egg, very near to the site of last year's nest, the second egg being laid on the 27th. The first of these eggs hatched on June 16th, the second the next day. A second pair of Roseates arrived and successfully hatched off, but in both cases only one young one reached adult life. There were a few pairs of Arctic Terns identified in the Colony. During the last week in June the weather was very cold and hundreds of young Terns, mostly Common, died as soon as hatched, apparently

from exposure. On the whole, however, the birds did well. During July the Ternery was over-run by hundreds of young birds. On July 16th Captain A. W. Boyd ringed 160 young Sandwich Terns. The last Sandwich Tern's egg to be hatched out was on July 16th, and by this date there were still left a few Common Terns' nests with eggs. A pair of Oyster-catchers nested on the Far Point in the middle of the Ternery, and hatched off on July 17th.

Scolt Head Island

On an island like Scolt Head, which lies on the migration route and is little disturbed, there is considerable variation in its bird population, and during the past year this has been marked. The island not only provides nesting sites for several species, but it also affords resting places and extensive feeding-grounds for large numbers of visitors. January and February were exceptionally cold months and, as usually happens under such conditions, most of the surface-feeding ducks, except wigeon, eventually moved further south. On the other hand the north Norfolk estuaries were invaded by an unprecedented number of Brent Geese, and by the middle of February there were from 500-1,000 of these birds to be seen and heard daily feeding in the creeks along the mud-flats of the island. From a distance the noise made by them resembled the baying of a pack of hounds. The first Brents were seen on January 14th and the last had not left the island until April 13th. They ate up every blade of Wigeon Grass (*Zostera*) on the island. A few were shot by local gunners, but they were so thin that they were not considered eatable and were left unmolested. Gray Geese visit us every year in very large numbers but Brents and Bernicles are rarely to be seen on the Norfolk Coast. At Blakeney a similar invasion occurred, and here 101 were shot by a gunner in five days during the last week of the month. On January 21st 10 Short-eared Owls were found in the dunes near the hut. These birds remained about the island until the end of April and a pair were frequently found in the neighbourhood of their nest of last year, but eventually they left and no owls nested on the island this year.

During the middle of February the cold was extreme. There were thousands of Snow Buntings and many Shore-

larks on the island, and on the 18th the watcher estimated that there were some 500 Sheld-ducks, the largest number he had ever seen. Waders of all kinds were numerous and were dying from starvation, the frost being so severe that their feeding-grounds froze as soon as they became uncovered by the receding tide ; the Hooded Crows took advantage of these conditions and in many cases dealt the final blow. Several Mergansers were to be found in the creeks, and a large number of Common Scoters came into the harbour, while swans were seen passing on several days. In spite of this unusually cold weather the Spring migrants were not delayed in their arrival. The first Wheatear was seen on March 27th, and on April 9th the first Sandwich Tern was seen at sea by a local fisherman, H. Loose. By this date Sheld-ducks were getting to the dunes, prospecting for nesting sites ; and by the 15th a pair of Oyster-catchers were scraping out their nest of last year. By April 17th a Ringed Plover's nest with egg was found. On April 18th the first Sandwich and Common Terns were seen, and on the 20th many Swallows and Martins were observed going west. The first Oyster-Catcher's egg was found on April 26th. There were 16 nests of these birds on the island this year, and two on the Nod ; all these hatched off. By the first week in May there were many Ringed Plovers' nests. On the 9th a pair of Swallows returned to the coalhouse at the back of the hut and again nested in exactly the same spot as last year—on the bottom of an up-turned box.

The first Common Tern's egg was found on May 19th and two days later the first egg of the Little Tern. On this same day, the 21st, there were 21 eggs of the Sandwich Tern. For some unexplained reason these Sandwich Terns all forsook their eggs and moved off to the eastward—presumably to Blakeney Point—and this year there were no Sandwich Terns hatched on the island, although the birds from Blakeney Point frequently paid visits—often as many as 200 at a time. The first-discovered egg of the Common Tern hatched out on June 4th (incubation 17 days). On June 7th and 8th exceptionally high tides came and washed out many Common Terns' eggs. These were moved higher up by the watcher and the birds resumed sitting. On June 14th the island was covered by blowing sand and many young chicks were choked as they were hatching.

BRITISH
MUSEUM
25 FEB 30
NATURAL
HISTORY.

Photo] [*D. Carruthers*

DIAL HOUSE, BRANCASTER STAITHE

Recently bought by the Norfolk Naturalists Trust for the Watcher of Scolt Head Island. The two rooms on the left of the porch are reserved for visitors. The barn, used as a garage, is seen behind the house.

JIM LINKHORN

Well known to many ornithologists as one of the keepers on the Hickling Reserve. He caught the bittern by stalking it in the reed-bed. When released it flew to an adjacent reed-bed and within five minutes was again booming.

On the 25th there was a strong gale from the north-west with a very high tide which washed out many nests and most of the chicks of the Common and Little Terns were either drowned or choked by blown sand. Second clutches were laid, and these hatched off successfully. During the latter half of June and most of July a pair of Harriers were to be seen almost daily on the island, but there was no evidence that they nested. One of these birds was seen to pick up a young tern on the breeding ground, quite regardless of the mobbing it received from the parent birds. On July 23rd and 24th the watcher identified two Roseate Terns at the Ternery; these were almost certainly the birds which nested on Blakeney Point. The number of Little Terns nesting on Scolt Head has been increasing from year to year and during the past season the watcher counted 204 nests, distributed all along the shingle beaches. Of Common Terns' nests 382 were counted, but it is impossible to say how many of these successfully hatched off. Several Mallards nested on the island, and Redshanks' nests were numerous.

During the year a house, known as "Dial House," has been purchased in Brancaster Staithe by the Norfolk Naturalists Trust as a permanent residence for the watcher. It was formerly the "Victory" Public House, and as part of the property there are a large Brew House, barn (built of hard chalk) and a commodious yard. The Trust has reserved and furnished a bedroom and a sitting room in the house, which are let to visitors by arrangement with the watcher's wife, Mrs. Chestney. The brewhouse has been adapted for a museum and laboratory, and the barn provides garage accommodation. These various improvements, painting, furnishing, etc., have added to the original purchase price of the property, namely £540, by about £150, towards which the sum of £513 16 0 has already been subscribed. This "Dial House Fund" remains open in the hope that some of our supporters will help us to wipe out this deficit. The property is situated on the edge of the saltings at the head of the harbour and commands an uninterrupted view of the island.

Broadland

We are indebted to Mr. Jim Vincent, head keeper to Lord Desborough, for the following notes in connexion with the bird life in the Hickling area during the past season :—

Many birds suffered from the severe and prolonged winter's frost, and no less than nine dead or moribund Bitterns were picked up. We heard of two more starved Bitterns being found on an adjacent broad. Three found their way to the Cley marshes, but these, too, became frozen up, and the fate of these birds is unknown. It is estimated that about four pairs of Bitterns nested at Hickling this year, but, wisely, there was no search for their nests. The cold also depleted the numbers of Water Rails, Waterhens and Coots, as was reflected by their decrease in the breeding season. Among Bearded Tits there was a heavy death toll during the winter. About a dozen pairs survived and, judging by the numbers seen in the autumn, several of these had two, and perhaps three, broods. On November 13th Vincent saw ten on Starch Grass, the recently-acquired marsh of the Norfolk Naturalists Trust, so that the outlook is encouraging.

On March 12th the broad began to open up once more and there were then large flocks of Tufted ducks, Pochards, Mallard and Teal, forty Goldeneyes, two Goosanders, a few Great Crested Grebes and thirty Bewick swans all revelling in the thaw. These swans left at 8 p.m. on March 28th.

A Little Bittern was seen flying across the broad by one of the reed cutters on March 27th. On the next day three pairs of Garganeys arrived and it is computed that from six to eight pairs nested. It was not until March 30th that Bitterns were heard grunting ; in ordinary years they would have been booming a month earlier than this.

Harriers.—The Broads district of Norfolk may be considered to be the home of the Harriers in England at the present time, and it is satisfactory to be able to report that both the Marsh and the Montagu continue to nest with us. On April 5th a male Marsh-Harrier arrived, which later was joined by a female. But it was not until May 30th that the first egg was laid, though in 1928 there were full clutches by May 7th. Four eggs were laid this year and two young reached maturity. The male parent and one of the young remained in the district until the last day of October.

The first Montagu Harriers were seen on April 22nd, and seven pairs stayed to breed, one bird laying the abnormal clutch of eight eggs. This year, for the first time, a male

Montagu Harrier has been observed to visit the nest. Once it was flushed from the nest by Vincent, and by the courtesy of Mr. Ian Thomson we are able to reproduce a photograph of both birds at the nest.

It is impossible to record all the birds that visited the Broads during the year, but mention must be made of two Black-winged Stilts that came to Hickling on May 24th. Grasshopper warblers were plentiful, and there were more pairs of nesting Yellow Wagtails than have been seen for some years. A pair of Common Pochards nested, but there is no evidence that Tufted ducks nested this year.

Of other visitors to Hickling may be mentioned several Ruffs and Reeves, which were about the marshes from the middle of April to the end of May; a Red-necked Grebe on April 5th and a pair of Black-necked Grebes on the 19th.

The Osprey is a bird that almost regularly visits the county during its northward migration, and we have seen it on the Broads and also on more inland waters. This year one arrived at Hickling on April 28th, where it stayed for several days and was seen by a number of ornithologists. This bird, unfortunately, came to an untimely end and was picked up at Catfield, mortally wounded by shot, on May 16th.

Of the many interesting birds that have now visited us for many years the Spoonbill is, perhaps, the most tantalising. It comes to Breydon Water, within a stone's throw of its former historical nesting place—Reedham church wood; to the Broads—there were four on Hickling on May 7th—and to the Cley Marshes. It is never molested nor even disturbed. Why, then, does it not nest here, when such suitable nesting sites and feeding grounds are provided? Only the bird itself can supply an answer.

Signed (on behalf of the Norfolk W. B. P. Committee),

SYDNEY H. LONG. *Hon. Sec.*

THE WILD BIRDS PROTECTION (ADMINISTRATIVE COUNTY OF NORFOLK) ORDER, 1929. DATED MAY 1, 1929

BIRDS

Close Time extended

II.—(*a*) Throughout the Administrative County of Norfolk, except the range of hills and foreshore known as Blakeney Point,

the period during which the killing or taking of Wild Birds is prohibited by the Wild Birds Protection Act, 1880, shall be extended.

(1) so far as regards snipe, teal, wigeon and all other species of wild duck so as to be between the 10th day of February and the 1st day of August in each year with the exception of the foreshore and sandhills and marshes adjoining, as defined in paragraph VI (*c*) of this Order, the close time for which shall be between the 1st day of March and the 1st day of August in each year.

(2) so far as regards woodcock so as to be between the 1st day of February and the 13th day of August in each year.

(3) so far as regards all other Wild Birds mentioned in the Schedule to that Act, as amended by the Act of 1881, or added thereto by Clause III of this Order, so as to be between the 1st day of March and the 1st day of September in each year.

(*b*) Throughout the Blakeney Point District above referred to the close time shall be extended (1) so far as regards snipe, teal, wigeon and all other species of wild duck so as to be between the 10th day of February and the 1st day of September in each year and (2) so far as regards all other Wild Birds so as to be between the 1st day of March and the 1st day of September in each year.

Additions to the Schedule of the Act of 1880

III. The Wild Birds Protection Act, 1880, shall apply within the Administrative County of Norfolk to the following species of Wild Birds in the same manner as if those species were included in the Schedule to the Act :—

Great Bustard,
Corncrake,
Crossbill,
Fly-catcher,
House-Martin,
Quail,
Sand Martin,
Swallow,
Swift,
Bearded Tit (Reedling or Reed Pheasant),
Warbler (all species).

Certain Birds protected during the whole of the Year

IV. During that period of the year to which the protection afforded by the Act of 1880, as varied by Clause II. of this Order, does not extend, the killing or taking of the following

species of Wild Birds is prohibited throughout the Administrative County of Norfolk :—

Avocet,
Bittern (all species),
Great Bustard,
Buzzard (all species),
Crossbill,
Dartford Warbler,
Diver (all species),
Eagle (all species),
Black-tailed Godwit,
Fly-catcher (all species)
Goldfinch,
Grebe (all species),
Harrier (all species),
Hobby,
Hoopoe,
Kingfisher,
House-Martin,
Golden Oriole,
Osprey,
Owl (all species except Little Owl),
Phalarope (all species),
Red Poll,
Ruff and Reeve,
Sandgrouse,
Siskin,
Spoonbill,
Black-winged Stilt,
Stork,
Swallow,
Swift,
Blue-Throat and all species of Warblers,
Bearded Tit (Reedling or Reed Pheasant),
Woodlark,
Woodpecker (all species).

All Birds protected on Sundays in certain Areas

V. During that period of the year to which the protection afforded by the Act of 1880, as varied by Clause II. of this Order, does not extend, the killing or taking of Wild Birds on Sundays is prohibited within the areas described in Article VI. paragraphs (*a*), (*b*), (*c*), (*d*), (*e*) and (*f*) of this Order.

EGGS

All Eggs protected in certain Areas

VI. The taking or destroying of the eggs of any species of Wild Birds is prohibited during the period of five years from the date of this Order, within the following areas :—

(*a*) Hickling Broad, Whitesley and Heigham Sounds, Blackfleet Broad, Horsey Mere, Martham and Somerton Broads, and the rands, skirts, and walls thereof, and fens and reed grounds appertaining thereto respectively, and the islands therein, and the dykes communicating therewith, including the Hundred Stream or Thurne River and ancient bed, and the rands and walls thereof from Heigham Bridge to the sea at Winterton, and all the marshes and low-lying uncultivated lands, fens, reed grounds, warrens, marram or sand hills and sea shore, to the line of high-water mark, in the several parishes of Waxham, Horsey, Potter Heigham, and Hickling, and such part of the parish of Catfield as lies to the east of the Midland and Great Northern Joint Railway.

(*b*) The warrens, marram or sand hills and sea shore, to the line of high-water mark, in the parish of Winterton.

(*c*) Such parts of the Rivers Yare and Wensum as are within the Administrative County of Norfolk, and the streams communicating therewith ; the River Bure and the streams communicating therewith ; and Rockland and Surlingham Broads and the rands, skirts, and walls of each such river and broad, and fens and reed grounds appertaining thereto respectively, and the islands therein, and the dykes communicating therewith.

(*d*) The series of Broads known as Ormesby, Rollesby, Hemsby, Filby, and Burgh Broads, and the rands, skirts, and walls thereof, and the dykes communicating therewith, and the fens, reed grounds, and low-lying lands, marshes and pastures adjacent thereto, including Lady Broad or Hard Fen Water, in the parish of Filby, Brandyke Broad, in the parish of Burgh St. Margaret, and Muckfleet Dyke, and the marshes and low-lying lands and pastures near or adjacent thereto respectively.

(*e*) The whole of the foreshore of the County of Norfolk, including the shingle, sand hills, salt marshes, creeks, and other unenclosed lands extending from high-water mark to the first boundary of enclosed or cultivated land separating the foreshore from them.

The approximate position of the rivers, open broads, and foreshores referred to above is shown in blue on a map deposited with the Clerk of the County Council, sealed with the Home Office Seal and dated the 1st May, 1929.

(*f*) The range of hills and foreshore known as Blakeney Point, which area is coloured red on a map, similarly sealed and dated, and deposited with the Clerk of the County Council.

Certain Eggs protected throughout the County

VII. The taking or destroying of the eggs of the following species of Wild Birds is prohibited throughout the Administrative County of Norfolk :—

Avocet,
Bittern (all species),
Great Bustard,
Buzzard (all species),
Crossbill,
Stone Curlew (Norfolk Plover or Thick-Knee),
Fly-catcher (all species),
Black-tailed Godwit,
Oyster-Catcher (Sea Pie),
Ringed Plover (Ringed Dotterel or Stone Runner),
Quail,
Land Rail or Corncrake,
Water Rail,
Redstart,
Ruff or Reeve,
Common Sandpiper,

Goldfinch,
Grebe (all species),
Harrier (all species),
Hawfinch,
Hobby,
Kingfisher,
Wood Lark,
Lapwing (Peewit or Green Plover),
Magpie,
House Martin,
Sand Martin,
Nightingale,
Golden Oriole,
Owl (all species except Little Owl),
Red-backed Shrike (Butcher Bird),
Spoonbill,
Swallow,
Tern or Sea Swallow (all species),
Swift,
Bearded Tit (Reedling or Reed Pheasant),
Grey Wagtail
Yellow Wagtail,
Dartford Warbler,
Warblers (all species),
Wild Duck and Teal (all species),
Woodcock,
Woodpecker (all species),
Wryneck.

Repeal of former Order

VII. The Order of the 6th August, 1925, is hereby repealed.

Given under my hand at Whitehall, this 1st day of May, 1929.

W. Joynson-Hicks,
One of His Majesty's Principal Secretaries of State.

LIST OF SUBSCRIPTIONS AND DONATIONS TO THE NORFOLK WILD BIRDS PROTECTION FUND FOR 1929

	£	s.	d.
H.M. THE KING	3	3	0
H.R.H. The Prince of Wales, K.G. ...	2	2	0
Adam Miss H. ...	1	1	0
Agnew C. G.	1	1	0
Allars R. W. E. ...	3	3	0
Allen J. W. ...	2	2	0
Anderson Edward ...		10	0
Arnold E. W. ...		10	6
Back H. W.		10	0
Baker E. S. Stuart ...	3	3	0
Barclay F. H. ...	1	0	0
Barclay H. G. ...	2	2	0
Barclay Miss M. ...		10	0
Barclay-Smith Miss P.		10	6
Barlow J. Allen, C.B.	1	1	0
Barnard Mrs. ...	1	1	0
Barrow Miss		10	6
Barry W. J.	1	1	0
Barton S. J., M.D. ...	1	1	0
Bedford, Her Grace the Duchess of ...	2	2	0
Beevor Sir Hugh, Bart.	1	0	0
Carried forward ...	£29	4	6

	£	s.	d.
Brought forward ...	29	4	6
Benn Sir Ion Hamilton	1	1	0
Bewly Miss N. ...		5	0
Blackburn C. J. ...	2	0	0
Blakeney Point Collecting Box	1	5	0
Boardman E. T. ...	1	0	0
Boileau Sir M., Bart.	1	1	0
Brash T.	2	2	0
Briscoe Lieut. F. M. Eliot-Drake .		10	0
Brittain H. ..	1	0	0
Brooks J. R.... ...	1	1	0
Brown E.	1	1	0
Brown H.	1	1	0
Buckle Lt.-Col. D. W.	1	1	0
Bullard Ernest ...	1	1	0
Bulwer Col. E. A. ...	1	0	0
Burrowes R. B. ...	1	0	0
Burrows Mrs. ...	2	0	0
Butcher R. W. ...	1	1	0
Buxton E. G. (the late)	2	2	0
Buxton G. F. (the late)	3	3	0
Carried forward ...	£54	19	6

	£	s.	d.
Brought forward ...	54	19	6
Buxton W. L. ...	1	1	0
Byne Lt.-Col. R. M. ...	1	1	0
Byers J.		10	0
Calley Miss J. M. ...	3	3	0
Candler Charles ...		10	6
Capron J. T.	1	1	0
Carr Mrs. Laurence ...		10	0
Carruthers D. ...	2	2	0
Cassie R. L.		10	0
Castle J. W.	3	3	0
Cave Walter F. ...	2	2	0
Chadwick Dr. Morley	2	2	0
Chapman E. H., His Honour Judge ...	3	3	0
Christie J. A., M.P. ...	1	0	0
Churchill Mrs. Arnold		10	0
Cleave H. P. O. ...	1	1	0
Cleminson H. M. ...	1	0	0
Clutton Bryan ...	3	3	0
Coe Mrs. A. E. ...		10	0
Colman Miss E. ...	1	1	0
Colman Miss H. C. ...	1	1	0
Colman R. J. ...	1	1	0
Colomb Admiral P. H., C.B.	1	0	0
Cooke A., F.R.C.S. ...		10	0
Cowper Johnson K. ...	1	0	0
Cozens-Hardy A. ...	1	1	0
Cresswell Mrs. George	1	1	0
Davy G.		10	0
Deacon Dr. G. E. ...		10	0
De La Warr, Lady ...	1	0	0
Dewar T. F., C.B., D.Sc., M.D. ...		10	0
Dewrance Sir John, G.B.E.	2	2	0
De Worms C. ...	1	1	0
Doughty C. G. ...	1	1	0
Drury G. L.		10	6
Duncanson T. J. G. ...	3	3	0
Eccles James R. ...	1	1	0
Ennion E. F. R. ...		10	6
Ferrier Miss Judith ...		10	0
ffolkes Sir W., Bart....	1	1	0
Finch F. R.	1	1	0
Flowers John, K.C. ...	1	1	0
Forbes H.	1	1	0
Friedlein W. ...		10	6
A Friend		10	0
Garrod F. W.... ...	1	1	0
Gay Miss C. E. ...	1	1	0
Gayner Dr. J. S. ...	1	1	0
Giles C. C. T. ...		5	0
Glanville J. P. ...	1	1	0
Glegg W. E. ...	1	0	0
Goddard W. N. ...		10	6
Carried forward ...	£114	10	0

	£	s.	d.
Brought forward ...	114	10	0
Gowen H. P.... ...	1	1	0
Graves Mrs.	1	1	0
Green Major E. A. Lycett		10	0
Gresham School Nat. Hist. Soc.	1	1	0
Gurdon E. T. (the late)	1	1	0
Gurney Q. E. ...	1	1	0
Gurney G. H. ...	2	2	0
Gurney R., D.Sc. ...	2	2	0
Gurney W. S. ...	1	1	0
Hannaford G. ...	2	2	0
Harding J. Rudge ...		10	0
Harker W.	1	1	0
Harmer T. Bertrand...	1	0	0
Harrison J. H. ..		15	0
Haydon W.		5	0
Herbert E. G. ...		10	0
Heywood R.	1	1	0
Higham W.		10	0
Hill T. A. M. ...	1	1	0
Holland C. B. ..		10	6
Hollom P. A D. ...		10	0
Hopwood Miss M. ...	1	0	0
Horsfall R. E. ...		10	0
Howlett Dr. J. K. ...		10	0
Hudson Lt.-Col. Percy C.M.G., D.S.O. ...	1	0	0
Hughes W.	1	1	0
Hyslop A. B. ...	2	2	0
Hyslop Brig.-Gen. H. G., D.S.O. ...	1	1	0
Jago Cyril		10	0
Jenkins Rev. T. L. ...	1	0	0
Jessop A. L. ...	2	2	0
Jones Sir L., Bart. ...	1	1	0
Jones Lawrence E. ...	3	3	0
Ketton-Cremer W. C.	1	1	0
Keith E. C.	1	10	0
Kennaway Dr. E. L.		10	0
Kerr Mrs. M. Rait ...	1	1	0
Kinder Rev. E. H. ...	1	1	0
Knight E.	1	0	0
Kolle H. W.	2	2	0
Lang Gordon L. ...	2	2	0
Lee-Elliott Rev. D. L.	1	1	0
Littlewood Miss ...		10	0
Lister S. R., M.D. ...		11	0
Lewis J. Spedan ...	4	4	0
Lloyd Capt. L. ...	1	0	0
Long Miss		5	0
Long S. H., M.D. ...	2	2	0
MacAlister Donald A.	1	0	0
MacAlister Mrs. ...	6	1	0
McHardy Maj.-Gen. A. A., D.S.O. ...		10	6
Carried forward ...	£177	17	0

	£	s.	d.
Brought forward ...	177	17	0
Macpherson A. Holte	1	1	0
McKenzie Miss G. ...		10	0
McKittrick T. H., Jun.	2	2	0
McLean C.	1	1	0
Marshall J. M., J.P....	1	1	0
Masters Miss M. G. ...		10	0
Matthews T. G. ...	1	1	0
Maynard Miss J. ...	1	1	0
Meade-Waldo E. G. B.	1	1	0
Meadows Mrs. A. H....		10	0
Mennell E.		5	0
Micholl Mrs.	1	1	0
Milne Mrs. Findlay ...	1	1	0
Mitchell Arthur ...	1	1	0
Moxey Mrs.	1	0	0
Murton Mrs. ...	1	0	0
Nash John E. ...		5	0
Nash W.	1	0	0
National Trust, The...	10	0	0
Naylor W. S. ...	1	1	0
Newman Miss F. B. ...		10	0
Pain P.	1	1	0
Parker George ...	1	1	0
Pearson S. V., M.D. ...		10	0
Penrose F., M.D. ...	1	1	0
Perrin Percy ...	1	1	0
Plowright Dr. C. T. ...	2	2	0
Poole Miss D. Lane ...		7	6
Powell A. M.... ...		5	0
Preston Sir E., Bart., D.S.O.	1	1	0
Purdy T. W.... ...	1	1	0
Ransome Mrs. ...	1	1	0
Raikes Miss D. T. ...		5	0
Reeves H.	1	1	0
Reid Dr. E. S. ...		10	0
Report, Sale of ...	3	10	4
Riley W.	1	1	0
Ringrose B. J. ...	1	1	0
Riviere B. B., F.R.C.S.	2	2	0
Rogers Rev. H. ...	1	0	0
Royal Society for the Protection of Birds	2	2	0
St. Quintin W. H. ...	1	1	0
Sanders Rev. A. H. W.		5	0
Savill Harry	2	2	0
Savin A. C.		5	0
Carried forward ...	£232	15	10

	£	s.	d.
Brought forward ...	232	15	10
Savory Mrs.		10	0
Scolt Head Collecting Box	4	2	6
Schreiber P. G. ...	1	0	0
Sheldon W. G. ...		10	6
Simmonds C. E. ...		5	0
Simpson F. T. ...	2	2	0
Smith Col. H. F. ...	1	1	0
Soman A. E. & Co., Ltd.	1	1	0
Spalding G.		10	0
Sparrow Col. R. ...		10	0
Southwell E. B. ...	1	1	0
Steward Rev. Canon Edward	1	1	0
Stimpson E. ...	1	0	0
Sumpter Dr. B. G. ...	2	2	0
Tancock Canon O. W.		5	0
Taylor Dr. Mark ...	1	0	0
Thompson C. R. W.		10	0
Thorpe W. H. ...	1	1	0
Thouless H. J. ...		10	0
Tuke Anthony W. ...	1	1	0
Turner Edgar ...	1	2	0
Turner E. G. ...	1	1	0
Upcher H. E. S. ...	1	0	0
Upcher Miss L. ...	2	2	0
Vincent T.		5	0
Walmisley Miss V. ...		10	0
Walter C. H. ...	1	1	0
Watson J. B. ...		10	0
Watson-Kennedy Mrs.	1	1	0
Webb-Ware Mrs. ...		10	0
Wells C. H.	1	1	0
Wemyss Major G. ...	1	0	0
Whittaker W. I. ...	1	1	0
Winch Major S. B. ...	2	2	0
Wishart E. E. ...	5	0	0
Whymper S. L. ...	1	1	0
Wormald H.	1	1	0
Wright B. D. Z. ...		10	0
Wright T. J. ...		10	6
Wyllys H. J. M. ...		10	0
Wyllys W. E. ...		10	0
Yeo H.		10	6
Yeo Mrs.		10	6
Total ...	£278	8	4

NORFOLK WILD BIRDS PROTECTION FUND

Year ending December 31st, 1929

Receipts

	£	s.	d.
Balance brought forward from 1928 ... ... 86 18 7			
Subs. for 1929 paid in 1928 ... 8 7 6			
	95	6	1
Subscriptions and Donations, 1929	261	3	0
Blakeney Point Collecting Box	1	5	0
Scolt Head Collecting Box ...	4	2	6
Sales of Report	3	10	4
Donations for Field-glasses for Watchers		14	0
	£366	0	11

Expenditure

	£	s.	d.
Breydon Watcher's Wages and Insurance	42	13	6
Oil, Coal, etc., for Breydon House Boat	1	0	6
Scolt Head Watcher's Wages and Insurance to Nov. 7th, 1929	119	6	5
Axe for Watcher		7	0
Blakeney Point—Contribution to Watcher's Wages	30	0	0
Honorarium to Edith Pinchen ...	2	2	0
2 doz. Rat Traps	1	18	0
Mattresses for Watcher's House Boat	5	17	0
Oil Stove for do.	1	6	8
Printing of Annual Report ...	8	13	6
Printing and Receipt Books ...	1	3	0
Postage and Watchers' Diaries	8	5	0
2 Zeiss Field-glasses for Watchers	5	5	0
Guernsey and Oil-skin for Watcher	1	18	6
Cheque Books		6	0
To Deposit a/c	50	0	0
To the Norfolk Naturalists' Trust, towards purchase of "Dial House"	80	0	0
Balance	5	18	10
	£366	0	11

Deposit

	£	s.	d.
Balance, 31st December, 1928 ...	82	10	2
Interest to June 30th, 1929 ...	2	12	6
Transfer from Current a/c ...	50	0	0
	£135	2	8

XI.

METEOROLOGICAL NOTES, 1928

(From observations taken at Norwich)

By Arthur W. Preston, F.R.Met. Soc.

JANUARY

New Year's Day saw a break up of the severe frost which had prevailed during the last week of December, and was followed by mild, stormy weather, with much rain and bright intervals and an occasional morning frost. The rainfall of the month (3.77 in.) was the greatest amount registered here in any January since 1922. The heaviest rain occurred

on the 2nd (.90 in.), and this downpour accompanying the melting of the heavy snows of the previous month occasioned disastrous floods in many places. A heavy gale occurred on the 6th with a velocity of 54 miles an hour. Mean temperature (40.2 deg.) was 2.6 deg. above normal, and the month was the sixth successive January with an excess of temperature.

FEBRUARY

Frequent storm centres from the Atlantic caused a continuance of the mild stormy weather which had characterised January, up to the 17th, when a dry time set in and continued to the end of the month. During the first fortnight there were no less than six days on which the wind rose to gale force, the heaviest gale being on the 10th, when the wind rose to 50 miles an hour. Thunderstorms, unusual in February, occurred on the 1st, 10th, and 11th. On the latter day at about 5.30 p.m. a brilliant flash of lightning struck the electric light plant of Norwich putting nearly the whole of the city into darkness. Mean temperature of the month (42.1 deg.) was 3.4 deg. above the average, and the rainfall (1.49 in.) 0.15 in. below. There was no snow.

MARCH

In the first week there were some warm days, the thermometer reaching 63.4 deg. on the 4th. On the 6th a cold spell set in, the maximum on the 11th being only 33 deg. Much winterly weather occurred at this time with snowstorms on the 9th, 10th, 11th, and 12th, the snow lying 5 in. deep on the morning of the 12th. From the 17th the weather was generally mild. The month's rainfall (1.68 in.) was 0.28 in. deficient. A rather sharp thunderstorm passed over the city on the afternoon of the 30th. Mean temperature (43.3 deg.) was 1.8 deg. in excess of the normal. Sunshine was 15 hours deficient.

APRIL

After commencing with four cold days, a fine, warm period coinciding with the Easter holidays followed. An abrupt change to winterly conditions ensued, and from the 13th to the 22nd the temperature did not once touch 50 deg. On the 18th it fell by night to 28.5 deg. in the screen and to 24 deg. on the

grass. Slight snow and sleet fell almost daily between the 15th and 20th. The last week was warm, the thermometer reaching 71 deg. on the 26th. Mean temperature (47.4 deg.) was 1.1 deg. above and the rainfall (1.50 in.) 0.21 in. below their respective averages.

MAY

From the 3rd to the 7th there was a short period of fine, bright weather, but from the 8th to the 24th there was hardly a warm day and a great prevalence of cold, bleak weather, with much north wind and cold showers. From the 24th an improvement took place and continued over the Whitsun holidays. On Bank Holiday the thermometer rose to 76.8 deg., a temperature which was not again reached until July 10th, and which was the warmest day since the 6th of the previous August. The total sunshine of the month was 30 hours deficient. The total rain (none of which fell after the 23rd) was 1.97 in., and approximately the normal. Mean temperature 51.4 deg.

JUNE

There were but few warm days during this month, the thermometer rising above 70 deg. on six days only, and the maximum for the month was only 74.2 deg., the same as in the previous June. The month was, however, much drier than the last-named month, the total rainfall having been 2.30 in. against 4.80 in. in 1927. The heaviest rain (.60 in.) occurred during a thunderstorm on the afternoon of the 26th. There were many windy days, the predominant direction of the wind having been between south and north-west.

JULY

This month was notable for the great outburst of heat which prevailed from the 8th to the 26th, and for the remarkable drought which accompanied it. Maximum temperatures of 85.1, 86.3, 85.9, 88.0 and 85.6 deg. were recorded on the 11th, 12th, 14th, 15th, and 22nd respectively, and on many other days during the month 80 deg. was nearly attained. The mean temperature of the entire month (64.2 deg.) was higher than in any previous July since 1923, and it was the sunniest July since 1921. Down to the 26th day only .13

in. of rain had been measured, but the last six days yielded 1.80 in., bringing up the month's total to 1.96 in. The period 9th to 24th was absolutely rainless. With the exception of some distant rumblings on the morning of the 27th, no thunder was observed throughout the month. Winds were mainly from the south-west, west, and north-west.

AUGUST

August was characterised by an unusually large number of fine, warm days, without any excessive heat as in July, and was consequently an exceedingly pleasant month. The highest temperatures observed were 77.8 deg. on the 11th and 77.1 deg. on the 24th, but it reached or exceeded 70 deg. on 15 other days. Mean temperature was in close agreement with the average, and the rainfall 0.57 in. below. The most frequent rain fell between the 19th and 27th, but none of the falls were very heavy. Thunder occurred on the 12th, 20th, and 27th, and lightning was seen on the evening of the 24th. Sunshine was 24 hours in excess of the normal, and it was the sunniest August since 1923. The Bank Holiday was very fine, and the harvest progressed under most favourable conditions.

SEPTEMBER

This month was noted for the great abundance of sunshine, causing a protraction of the splendid summer weather which had preceded it. The total sunshine was 64 hours above the normal amount, and it was the sunniest September since 1911. Rainfall was only 50 per cent. of the average, and down to the 28th only half an inch of rain had been measured. Temperature rose to 81 deg. on the 5th, and to 80.7 deg. on the 8th, and the mean temperature of the first ten days was higher than the normal for July. Easterly winds prevailed on several days, and the mean pressure for the month exceeded 30 inches.

OCTOBER

The first week was fine and warm with high pressure, the shade temperature exceeding 60 deg. on most days. From the 9th to the month's end a succession of cyclonic storms passed over the country from the Atlantic, rendering the

weather extremely unsettled, but with warm days intervening. The mean temperature of the month was 2 deg. above the average, and there was hardly any frost. With one exception (1921) it was the warmest October since 1910. Rainfall was slightly under normal, although rain fell on 19 days. Sunshine was 11 hours in excess.

NOVEMBER

November was an exceptionally mild and stormy month. Mean temperature (46.9) was the highest of any November since 1899. There were only three nights with frost in the screen, and these frosts were very slight. The total amount of rain (which fell on 24 days) was 2.94 in., and fell far short of the amounts recorded in many parts of the south-east of England. Cyclonic disturbances came in from the Atlantic with great frequency, and caused, particularly between the 13th and 26th, a constant succession of high winds and heavy gales, the latter being of unusual intensity on some days, particularly on the 16th, 23rd and 25th, when much damage was done both at sea and on land. On the 16th 66 miles per hour were registered at Gorleston, on the 23rd 53 miles per hour, and on the 25th 55 miles per hour. Thunder occurred on the 5th and 25th. Sunshine 66 hours. The mildness caused roses and other garden flowers to remain in bloom until the end of the month.

DECEMBER

Mean temperature was slightly under normal, but there was a mild spell at Christmas, on the evening on which day 55.2 deg. was registered, which was the highest reading in this neighbourhood on that day since 1854. There were 11 nights with frost in the screen and 24 on the grass. Cold drenching rains fell on the 29th and 30th, amounting to 1.49 in., bringing up the month's total, which promised to be below the average to .60 in. above. Sunshine was 14 hours in excess, and while there was not much fog there were many days of gloom and drizzle.

The Seasons

Tables of mean temperature and rainfall of the four seasons of 1928 (including December, 1927, but excluding December,

1928), and compared with those of the five previous years and with the average.

TEMPERATURE

Seasons	1923	1924	1925	1926	1927	1928	Average for 30 years.	Departure of 1928 from average
	degrees	degrees	degrees	degrees	degrees	degrees	degrees	degrees
Winter	41·3	37·3	41·6	39·7	39·4	39·3	38·4	+ 0·9
Spring	47·3	46·7	47·6	48·5	48·6	47·4	46·7	+ 0·7
Summer	60·3	60·2	61·5	60·6	59·7	61.8	60·2	+ 1·6
Autumn	47·8	51·2	48·2	50·3	49·9	51·9	50·1	+ 1·8
Year Jan. to Dec.	48·7	49·4	49·2	50·0	49·1	50·1	48·8	+ 1·3

RAINFALL

Seasons	1923	1924	1925	1926	1927	1928	Average for 35 years.	Departure of 1928 from average.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins
Winter	8·07	7·40	6·06	7·26	5·64	8·05	6·21	+1·84
Spring	3·95	6·58	6·31	4·70	4·23	5·15	5·55	−0·40
Summer	6·45	6·08	4·65	6·92	10·62	6·06	6·89	−0·83
Autumn	8·84	10·86	8·51	7·01	14·92	6·73	7·83	−1·10
Year Jan. to Dec.	27·74	30·77	25·10	24·66	36·90	26·41	26·48	−0·07

The winter was the fourth in succession warmer than the average, and the wettest (owing to snow) since 1923. The spring was also the fourth in succession warmer than the normal; the rainfall was 0.40 ins. deficient. The summer was the warmest since 1921, and, with 0.83 ins. deficiency of rain, was 4½ inches drier than the preceding summer. The autumn was the warmest since 1913. It yielded 8.19 ins. less rain than the autumn of 1927, and was the driest autumn since 1922.

THE YEAR.

The mean temperature of the year was 1.3 deg. above the average, and it was the warmest year since 1921. The warmest

month was July with a mean temperature of 64.2 deg. and the coldest month was December whose mean temperature was 39.0 deg. The warmest months in relation to the normal were February and November (3.4 deg. and 3.1 deg. respectively above) and the coldest was June (1.1 deg. below). The warmest day was July 15th (88 deg.) and the coldest night January 1st (17.6 deg.) The total rainfall of the year (26.41 ins.) was very near the exact average and 10 inches less than in 1927. The wettest month was January (3.77 ins.) and the driest was September (1.05 ins.). The total sunshine for the year (the returns for which were again kindly supplied by Mr. J. H. Willis) was 1,748 hours—the greatest amount in any year since the sunny year 1921, and 286 hours more than in 1927. Each month, June to December, inclusive, yielded an excess of sunshine. There were but few thunderstorms during the summer, but there were three in February and two in November, two months usually noted for their absence. Although the late spring and early summer were cool and disappointing, abundant compensation followed in the splendid weather which prevailed from the beginning of July until well into October.

MR. PRESTON'S METEOROLOGICAL RECORDS FOR 1928

1928 Month	BAROMETER Highest	Date	Lowest	Date	Mean	THERMOMETER Highest	Date	Lowest	Date	Mean	HYGROMETER Mean Relative Humidity 9 a.m	SUNSHINE Hours	RAINFALL Inches	No. of Days	WIND Direction and Days N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Mean estimated force
	in.		in.		in.	°		°		°	%												
JAN.	30.35	1	29.30	16	29.818	55.2	6	17.6	1	40.2	89	60.2	3.77	24	0	0	1	2	7	8	7	6	4.6
FEB.	30.57	20	29.64	11	30.028	56.0	15	29.0	4	42.1	84	98.2	1.49	15	0	0	2	5	4	3	11	4	3 9
MARCH	30.32	16	28.94	29, 30	29.800	63.4	4	25.8	11	43.3	82	109.1	1.68	18	2	4	5	10	5	2	1	2	3.1
APRIL	30.24	24	29.40	10	29.772	71.0	26	28.5	18	47.4	73	157.1	1.50	15	3	4	4	5	4	1	5	4	3.3
MAY	30.28	25, 26	29.10	16	29.896	76.8	28	32.0	11	51.4	74	170.1	1.97	13	7	3	9	3	2	0	1	6	3 3
JUNE	30.30	2	29.34	9	29.882	74.2	13	37.8	3	57.0	67	222.5	2.30	20	1	0	4	2	5	5	7	6	4.1
JULY	30.43	17	29.54	28	30.023	88.0	15	46 7	30	64.2	65	268.7	1.96	11	5	1	1	0	1	6	9	8	2.9
AUG.	30.23	31	29.54	20	29.900	77.8	11	45.0	31	61.2	73	208.4	1.80	17	1	3	2	2	3	10	6	4	3.7
SEPT.	30.33	13	29.68	28	30.093	81.0	5	37.2	26	56.7	75	213.6	1.05	12	4	3	8	4	2	1	3	5	3.4
OCT.	30.28	3	29.18	26	29.802	66.2	9	33.8	13	52.1	81	116.6	2.74	19	1	2	2	3	8	5	5	5	4.3
NOV.	30.26	29	28.58	16	29.706	59.8	12, 13	29.3	10	46.9	88	66.1	2.94	24	2	3	1	0	7	4	5	8	4.7
DEC.	30.46	18	29.18	30	29.976	55 2	25	23.4	9	39.0	88	57.4	3.21	24	3	1	4	2	5	4	6	6	2 3
MEANS					29.891					50.1	78												3 6
EXTREMES & TOTALS.	30.57	Feb 20	28.58	Nov. 16		88.0	July 15	17.6	Jan. 1			1748.0	26.41	212	29	24	43	38	53	49	66	64	

APPENDIX.

Annexed is a summary of the results obtained from meteorological and phenological observations, during the ten years 1918-1927, being a continuation of the tables given in Vol. VI of the "Transactions," pp. 342-347, Vol. VIII., pp. 739-746, and Vol. X, pp. 462-472.

TABLE I.

Absolute highest monthly and annual shade temperature during the ten years 1918-1927.

Year.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1918	55.0	58.0	69.5	59.2	81.0	77.2	80.0	90.8	72.2	62.0	59.0	57.8	90.8
1919	52.8	51.0	56.0	67.0	80.7	82.4	77.0	84.0	86.5	64.0	56.0	54.2	86.5
1920	55.0	57.2	66.0	63.8	77.8	78.0	77.0	72.3	71.5	72.0	59.4	55.4	78.0
1921	56.0	57.5	66.0	68.2	77.7	82.3	90.2	84.0	83.8	77.0	53.2	58.0	90.2
1922	56.4	59.0	59.0	65.4	88.7	82.0	75.5	73.0	70.0	64.0	53.0	52.6	88.7
1923	53.5	57.0	68.8	69.4	81.5	74.7	92.9	85.0	72.0	66.0	58.4	48.2	92.9
1924	50.2	49.4	58.4	64.1	77.6	80.7	85.6	75.4	71.0	68.8	58.0	54.0	85.6
1925	54.8	54.1	53.9	62.0	80.0	83.2	87.2	77.0	69.2	68.0	60.2	57.2	87.2
1926	52.7	56.5	59.0	74.5	73.0	77.0	83.0	78.7	86.0	70.2	55.0	50.0	86.0
1927	52.0	53.0	65.5	69.0	73.4	74.2	79.0	79.0	72.8	66.8	65.0	51.0	79.0
Extremes 1918-27	56.4	59.0	69.5	74.5	88.7	83.2	92.9	90.8	86.5	77.0	65.0	58.0	92.9
Extremes 1888-1927	56.4	64.0	70.0	75.4	88.7	90.4	92.9	93.5	93.0	78.4	65.0	58.0	93.5

TABLE II.

Absolute lowest monthly and annual shade temperature during the ten years 1918-1927.

Year.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1918	16.3	23.2	24.0	30.9	40.6	38.4	45.7	47.0	36.4	33.8	26.0	30.0	16.3
1919	27.0	12.0	24.0	28.0	36.5	38.0	42.5	39.2	31.7	31.2	25.0	24.2	12.0
1920	24.4	26.4	29.0	33.7	34.0	35.4	43.9	42.3	38.5	27.6	23.0	20.5	20.5
1921	28.6	26.2	28.5	31.5	32.7	39.2	42.3	41.0	38.6	38.3	23.0	25.0	23.0
1922	17.2	24.3	25.6	27.4	33.2	41.7	44.0	42.2	37.8	31.2	27.0	28.4	17.2
1923	28.6	29.0	30.6	30.9	33.0	37.0	48.5	43.0	40.5	32.2	21.2	24.0	21.2
1924	25.7	20.8	23.0	27.5	36.2	37.0	45.2	42.2	37.0	32.5	26.8	28.5	20.8
1925	26.3	23.7	24.4	26.1	36.5	43.7	48.0	45.9	41.2	32.2	25.4	16.2	16.2
1926	12.2	29.4	28.5	33.3	33.7	42.0	45.1	43.5	38.0	26.7	28.9	28.4	12.2
1927	26.2	24.2	32.4	29.4	28.5	42.5	43.8	46.0	35.0	32.0	31.1	14.2	14.2
Extremes 1918-27	12.2	12.0	23.0	26.1	28.5	35.4	42.3	39.2	31.7	26.7	21.2	14.2	12.0
Extremes 1888–1927	7.2	4.0	12.0	17.0	28.5	34.8	36.6	38.5	31.7	25.0	14.0	13.0	4.0

TABLE III.

Mean monthly and annual temperature during the ten years 1918-1927.

Year.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1918	37.6	42.9	42.9	44.0	55.6	56.2	61.4	62.5	55.2	48.7	42.0	43.9	49.4
1919	37.1	35.2	39.3	45.5	55.8	58.3	57.0	61.5	56.5	45.6	38.3	40.8	47.6
1920	40.7	42.1	46.3	48.3	55.3	59.4	59.9	57.4	57.1	50.7	42.9	39.7	50.0
1921	45.1	40.4	46.1	47.8	54.8	57.8	65.8	62.7	59.1	55.8	39.2	43.2	51.5
1922	37.3	40.0	40.9	43.1	56.6	57.9	58.0	57.8	54.9	48.3	42.1	42.0	48.3
1923	40.4	41.6	44.2	46.8	50.9	54.0	66.0	61.1	55.4	50.1	38.0	36.4	48.7
1924	38.8	36.7	39.4	45.7	55.0	59.4	62.1	59.1	57.5	51.6	44.6	42.8	49.4
1925	41.0	41.1	40.9	46.3	55.6	58.6	64.0	61.8	53.2	50.9	40.5	36.6	49.2
1926	38.3	44.3	44.0	50.3	51.3	57.1	62.5	62.1	59.4	47.3	44.2	39.4	50.0
1927	39.3	39.5	45.8	47.7	52.3	56.1	61.0	61.9	55.9	50.9	42.8	35.5	49.1
Mean 1918-27	39.6	40.4	43.0	46.6	54.3	57.5	61.8	60.8	56.4	50.0	41.5	40.0	49.3
Mean 1888–1927	38.4	39.1	42.0	46.3	54.3	58.0	61.4	60.9	57.1	50.0	43.2	39.4	49.1

TABLE IV.

Monthly and annual rainfall during the ten years 1918-1927

Year.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
1918	2.94	1.22	0.85	3.46	0.79	1.08	3.48	1.47	4.65	2.86	2.11	3.97	28.88
1919	2.94	3.38	2.30	1.82	0.86	1.27	2.62	2.26	0.88	3.53	3.08	5.05	29.99
1920	2.34	0.73	1.23	3.60	1.78	2.11	3.16	2.07	2.21	0.77	0.78	3.22	24.00
1921	2.03	0.33	1.19	1.71	1.27	0.55	0.50	1.52	1.31	1.50	1.84	1.96	15.71
1922	5.20	2.70	2.25	2.49	0.58	1.67	7.33	1.54	2.62	1.42	2.01	2.68	32.49
1923	1.85	3.54	1.58	1.09	1.28	0.83	3.30	2.32	1.95	3.62	3.27	3.11	27.74
1924	2.35	1.94	0.68	2.05	3.85	1.60	2.09	2.39	5.22	4.20	1.44	2.96	30.77
1925	1.07	2.03	1.76	2.50	2.05	0.61	1.68	2.36	3.09	1.70	3.72	2.53	25.10
1926	2.78	1.95	0.37	2.81	1.52	2.71	1.67	2.54	1.14	2.78	3.09	1.30	24.66
1927	2.23	2.11	2.05	1.55	0.63	4.80	2.47	3.35	7.15	2.60	5.17	2.79	36.90
Mean 1918-27	2.57	1.99	1.43	2.31	1.46	1.72	2.83	2.18	3.02	2.50	2.65	2.96	27.62
Mean 1888-1927	2.13	1.78	1.91	1.83	1.80	1.89	2.70	2.51	2.19	2.74	2.55	2.64	26.67

TABLE V.

Prevailing direction of wind each month during the ten years 1918-1927.

Year.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1918	S.	W.	E.	N.	N.	W.	S.W.	S.W.	S.	S.W.	S.	W.
1919	S.E.	S.E.	E.	W.	E.	N.W.	N.W.	W.	N.W.	W.	E.	S.W.
1920	S.W.	S.W.	W.	S.	S.W.	W.	S.	N.W.	S.W.	E.	S.W.	E.
1921	S.W.	N.E.	S.W.	N.E.	S.E.	N.E.	E.	W.	E.	E.	S.E.	W.
1922	S.	S.	N.E.	N.E.	S.	W.	S.W.	S.W.	N.	E.	N.W.	S.
1923	W.	S.E.	E.	E.	W.	N.W.	W.	W.	W.	S.W.	N.W.	S.
1924	S.	N.W.	S.E.	N.	S.W.	W.	W.	S.W.	S.W.	S.W.	S.E.	S.
1925	S.W.	S.W.	N.E.	S.E.	S.W.	N.	S.W.	N.W.	N.W.	S.	N.W.	N.W.
1926	S.	S.W.	W.	S.W.	N.E.	N.	N.	W.	N.W.	W.	S.	N.W.
1927	S.W.	S.W.	S.W.	N.W.	N.	N.W.	N.E.	S.W.	W.	N.W.	W.	E.
Prevailing monthly direction.	S.W.	S.W.	E.	N.E.	S.W.	W.	S.W.	S.W.	N.W.	S.W.	N.W.	S.

TABLE VI.

Number of days on which the wind blew from the eight points each month from 1918-1927.

Month.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
January	13	8	18	32	73	63	61	42
February	17	27	32	45	38	46	50	28
March	25	36	41	20	34	57	53	44
April	44	52	42	22	23	31	42	44
May	38	37	45	31	40	52	42	24
June	48	35	24	19	18	27	55	74
July	34	28	36	20	39	53	55	45
August	35	11	19	12	37	63	65	68
September	21	29	19	25	35	56	61	54
October	33	23	53	23	47	44	41	46
November	26	22	38	47	39	34	39	53
December	18	24	28	15	62	62	55	46

TABLE VII.

Number of days on which the wind blew from the eight points from 1918-1927.

Year.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
1918	43	28	26	33	60	69	65	41
1919	38	41	37	34	46	50	53	66
1920	25	29	52	35	54	76	56	39
1921	45	36	52	28	40	45	59	60
1922	37	42	45	21	51	56	60	53
1923	31	24	42	19	43	60	89	57
1924	21	26	33	42	67	64	59	54
1925	33	32	28	36	48	59	53	76
1926	44	42	32	37	39	56	63	52
1927	35	32	47	26	40	53	62	70
Average days 1918-27	35	33	39	31	49	59	62	57
Average days 1888-1927	35	37	37	30	46	59	66	55

Table VIII.

Dates of first leafing of Deciduous Trees, etc., during the ten years 1918-1927.

Trees, etc., Leafing.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	Averages. 1918-27	Averages. 1888-1927
Hawthorn	Feb. 26	Mch. 30	Feb. 10	Feb. 17	Mch. 18	Feb. 28	Apl. 1	Mch. 17	Feb. 27	Mch. 8	Mch. 7	Mch. 12
Sycamore	Apl. 3	Apl. 18	Mch. 24	Mch. 26	Apl. 25	Apl. 11	Apl. 2	Apl. 12	Mch. 11	Apl. 11	Apl. 5	Apl. 7
Horse Chestnut	Mch. 25	Apl. 14	Mch. 21	Mch. 17	Apl. 15	Mch. 25	Apl. 20	Apl. 10	Mch. 12	Mch. 21	Mch. 29	Apl. 4
Lime	Mch. 25	May 1	Mch. 27	Mch. 18	Apl. 18	Mch. 29	Apl. 23	Apl. 16	Mch. 18	Apl. 6	Apl. 6	Apl. 14
Birch	Apl. 1	Apl. 20	Mch. 28	Mch. 19	May 4	Apl. 3	Apl. 21	Apl. 16	Mch. 30	Apl. 11	Apl. 9	Apl. 18
Beech	Apl. 21	Apl. 28	Apl. 4	Apl. 1	May 1	Apl. 11	Apl. 27	Apl. 19	Apl. 9	Apl. 18	Apl. 17	Apl. 22
Elm	Mch. 29	Apl. 18	Mch. 7	Feb. 27	Apl. 15	Mch. 25	Apl. 21	Apl. 13	Mch. 14	——	Mch. 29	Mch. 27
Maple	——	Apl. 28	Apl. 3	Apl. 14	May 7	——	May 2	Apl. 23	Apl. 11	Apl. 28	Apl. 22	Apl. 28
Oak	May 9	May 1	Apl. 14	Apl. 3	May 12	Apl. 26	May 10	May 10	Apl. 9	Apl. 24	Apl. 27	May 1
Ash	May 16	May 17	Apl. 30	Apl. 17	May 9	May 3	May 14	May 17	May 13	Apl. 28	May 7	May 12
Foliage generally complete	May 31	May 31	May 26	May 22	May 30	June 12	June 3	May 31	June 3	May 29	May 31	June 2

TABLE IX.

Date of first flowering of Indigenous Plants and other natural phenomena during the ten years 1918-1927.

Plants, etc., flowering.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	Averages. 1918-27	Averages. 1888-1927
Anemone nemorosa ... (Wood anemone)	Mch. 18	Mch. 27	Mch. 8	Feb. 21	Apl. 14	Mch. 15	Mch. 29	Mch. 15	Mch. 4	Mch. 11	Mch. 16	Mch. 26
Ranunculus ficaria ... (Lesser celandine)	Mch. 4	Feb. 9	Feb. 18	Feb. 12	——	Feb. 3	——	Feb. 22	Mch. 4	Mch. 17	Feb. 21	Mch. 2
Sisymbrium alliaria ... (Hedge mustard)	Apl. 23	May 4	Mch. 28	Apl. 10	May 7	Apl. 1	May 8	Apl. 20	Apl. 4	Apl. 7	Apl. 17	Apl. 21
Stellaria holostea... ... (Great stitchwort)	Mch. 25	Apl. 19	Mch. 20	Mch. 26	Apl. 30	Apl. 28	Apl. 24	Apl. 11	Apl. 1	Apl. 16	Apl. 12	Apl. 13
Æsculus hippocastanum (Horse chestnut)	May 12	May 11	Apl. 12	Apl. 15	May 20	May 1	May 17	May 14	Apl. 14	Apl. 18	May 1	May 6
Prunus spinosa ... ... (Blackthorn)	Mch. 25	Apl. 19	Mch. 20	Mch. 20	Apl. 30	Mch. 31	Apl. 30	Apl. 11	Mch. 19	Apl. 14	Apl. 6	Apl. 12
Rosa canina ... ... (Dog rose)	May 26	June 12	May 23	May 24	June 5	June 17	June 15	June 10	June 3	June 8	June 5	June 9
Cratægus oxyacantha ... (Hawthorn)	May 12	May 21	Apl. 16	Apl. 19	May 18	May 6	May 20	May 15	Apl. 24	May 4	May 7	May 12
Anthriscus sylvestris ... (Wild parsley)	May 2	Apl. 19	Mch. 1	Feb. 24	May 7	Apl. 15	May 11	Apl. 26	Mch. 19	Apl. 18	Apl. 11	Apl. 20
Chærophyllum temulum... (Rough chervil)	May 26	May 25	May 20	May 16	June 5	May 6	June 5	May 24	June 13	May 29	May 26	June 1

TABLE IX. *Continued.*

Date of first flowering of Indigenous Plants and other natural phenomena during the ten years 1918-1927.

Plants, etc. flowering	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	Averages 1918-27	Averages 1888-1927
Chrysanthemum lucc.: ... (Ox-eye daisy)	May 29	May 23	May 17	——	May 31	May 18	May 27	May 24	May 31	May 29	May 23	May 22
Lamium purpureum ... (Red dead nettle)	Dec. 2	Mch. 9	Feb. 5	Nov. 11	Oct. 13	Oct. 12	Apl. 19	Mch. 25	Feb. 14	Feb. 22	Jan. 14	Jan. 26
Iris pseud'acorus ... (Yellow iris)	May 31	June 1	May 28	——	June 2	June 15	June 20	June 1	June 9	June 14	June 3	June 6
Scilla nutans ... ... (Bluebell)	Apl. 25	May 10	Apl. 16	Mch. 26	May 14	Apl. 11	May 14	May 5	Apl. 8	May 1	Apl. 25	Apl. 28
Hay cut	June 14	June 12	June 12	June 7	June 9	June 15	June 14	June 13	——	June 11	June 12	June 12
Wheat ear	June 16	June 13	June 12	June 6	June 23	July 3	——	——	June 24	June 18	June 18	June 17
Wheat cut	Aug. 9	Aug. 11	Aug. 6	July 23	Aug. 17	Aug. 8	Aug. 11	Aug. 3	Aug. 16	Aug. 19	Aug. 9	Aug. 9
Harvest finished	Oct. 1	Sept. 20	Sept. 18	Aug. 25	Sept. 30	Sept. 15	Sept. 20	Sept. 5	Sept. 8	Oct. 1	Sept. 17	Sept. 12
Cuckoo heard	——	Apl. 19	Apl. 24	Apl. 16	Apl. 25	Apl. 28	Apl. 19	Apl. 18	Apl. 19	Apl. 24	Apl. 20	Apl. 22
Nightingale heard ...	——	——	——	——	——	——	——	——	Apl. 15	——	——	Apl. 24

TABLE X.

Dates of first flowering of Garden Plants, Shrubs, etc., during the ten years 1918-1927.

Plants flowering.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	Averages. 1918-27	Averages. 1888-1927
Winter aconite	Jan. 19	Dec. 17	Dec. 31	Jan. 2	Jan. 22	Dec. 21	Jan. 20	Dec. 30	Jan. 23	Jan. 23	Jan. 8	Jan. 5
Snowdrop	Jan. 23	Jan. 20	Jan. 18	Jan. 2	Jan. 22	Jan. 14	Jan. 25	Jan. 14	Jan. 26	Jan. 24	Jan. 19	Jan. 18
Crocus	Jan. 27	Jan. 17	Jan. 25	Jan. 11	Feb. 14	Jan. 24	Feb. 18	Jan. 4	Feb. 2	Jan. 29	Jan. 26	Feb. 2
Daffodil	Feb. 27	Mch. 27	Feb. 29	Feb. 23	Mch. 11	Feb. 26	Mch. 26	Mch. 4	Feb. 23	Mch. 17	Mch. 7	Mch. 16
Ribes sanguineus ...	Mch. 1	Mch. 16	Feb. 24	Feb. 17	Mch. 6	Feb. 26	Mch. 23	Mch. 9	Mch. 9	Mch. 5	Mch. 5	Mch. 17
Lilac	May 9	May 15	Apl. 18	Apl. 4	May 14	May 2	May 15	May 14	Apl. 14	Apl. 26	May 1	May 8
Laburnum	May 16	May 16	Apl. 24	Apl. 21	May 30	May 3	May 20	May 14	Apl. 22	May 1	May 8	May 13
White pink	June 4	June 11	May 24	May 23	June 9	June 21	June 20	June 11	June 5	——	June 4	June 4
Lilium candidum... ...	June 26	June 30	June 18	June 17	June 26	——	June 28	June 24	——	——	June 25	July 4
Colchicum autumnale ...	Aug. 18	Aug. 24	Aug. 6	Aug. 4	Sept. 1	Aug. 22	Aug. 24	Aug. 14	Aug. 16	Aug. 24	Aug. 18	Aug. 24

XII.

FAUNA AND FLORA OF NORFOLK

Additions to Part XI.—Birds (Ninth List)* 1924—1928

By S. H. Long, M.D., F.Z.S., M.B.O.U., and B. B. Riviere, F.R.C.S., F.Z.S., M.B.O.U.

In the following we have attempted to bring together, to the end of 1928, such published, and other, information about some of the rarer birds that have visited Norfolk during the past five years, and the present status of certain others that breed in the county. In all cases we have given references, whenever possible. As in previous years, we have adopted the nomenclature of the last-published B.O.U. List of British Birds.

Greenland (Coues') Redpoll (*Acanthis linaria rostrata*).—A male of this race, the first to be recorded in Norfolk, was shot at Martham on January 4th, 1926, and identified by Dr. C. B. Ticehurst (Trans. N. and N. Nat. Soc., Vol. XII., p. 263).

Crossbill (*Loxia curvirostra*).—Continues to hold its own as a nesting species. There was a considerable immigration to the Norfolk Coast noted in the summer and autumn of 1925 and 1927.

Ortolan Bunting (*Emberiza hortulana*).—A male was killed at Cley on September 8th, 1927 "British Birds," Vol. XXI., p. 24).

Wood-Lark (*Lullula arborea*).—Becoming common in south-west Norfolk, and extending its range elsewhere in the county. Found breeding at Drayton, four miles north-west of Norwich, in 1925.

Grey Wagtail (*Motacilla boarula*).—Since 1923 a pair have bred each year at Taverham. No other nesting pair has been located.

Continental Blue Titmouse (*Parus cæruleus.*)—One identified as belonging to this race, was killed at Cley October, 1921. This is the first record for

* For previous Lists see Vols. IV., 259 and 397; V., 642; VI., 501; VII, 733; VIII., 847; IX., 784; X., 499; XI., 586.

England, but two have previously been recorded for Scotland ("British Birds," Vol. XIX, p. 241).

DARTFORD WARBLER (*Melizophilus undatus dartfordiensis*).—One was seen on January 9th, 1928, by Col. W. A. Payne, on a golf course by the sea. Only three have previously been recorded in Norfolk: two on Yarmouth denes and one at Wells ("British Birds," Vol. XXII., p. 249).

AQUATIC WARBLER (*Acrocephalus aquaticus*).—One was killed September 4th and another on September 5th, 1924, at Cley. On September 11th, 1925, one was killed at Blakeney ("British Birds," Vol. XVIII., p. 286, Vol. XIX., p. 241).

WOOD-WARBLER (*Phylloscopus sibilatrix*).—Still breeds each year at South Wootton. In 1925 B.B.R. was shown a small colony of three to four pairs at Blickling by Mr. Graves, who believes they have nested there for the past ten years.

NORTHERN WILLOW-WARBLER (*Phylloscopus trochilus eversmanni*).—One was killed at Cley, May 8th, 1924 ("British Birds," Vol. XVIII., p. 286). In all, several have been identified on the Norfolk coast both in spring and autumn.

REDSTART (*Phœnicurus phœnicurus*).—Five to ten pairs still nest annually in the South Wootton district (Tracy) and a few pairs near the Suffolk border; elsewhere still very scarce as a nesting species. A pair nested at Taverham in 1927, and four pairs were found nesting at Kelling in 1928 (A. P. Meiklejohn).

RED-SPOTTED BLUETHROAT (*Cyanosylvia suecica*).—One or two are usually to be met with at Cley in September. In 1927 several were seen in this month.

BLACK-BELLIED DIPPER (*Cinclus cinclus*).—In the late autumn of 1926 one or more Dippers were seen on the river Wensum, a mile or so above Norwich. These were probably of the Scandinavian form

as this is the usual race that occurs in Norfolk. Only two examples of the British race have been recorded for the county.

Red-Breasted Flycatcher (*Muscicapa parva*).—One obtained on Blakeney Point, October 2nd, 1925 (" British Birds," Vol. XIX., p. 241). Two were obtained (September 15th and 30th) and two more seen between Salthouse and Blakeney in September, 1928. (" British Birds," Vol. XXII., p. 249.)

Wryneck (*Iynx torquilla*).—A very rare bird in Norfolk now-a-days. On May 5th, 1927 S. H. L. watched one calling in a wood in the south-west of the county, but we have no knowledge of its nesting of late years.

Short-Eared Owl (*Asio accipitrinus*).—Five pairs nested in the Broads district in 1924, the largest number for many years. A pair nested on Scolt Head Island in 1925, 1926 and 1928.

Little Owl (*Carine noctua*).—Is now abundant throughout the county.

Marsh-Harrier (*Circus æruginosus*).—In 1927 a male and what appeared to be three females were present in the Broads district during the summer. A nest was made and three eggs laid, on which the female brooded for fourteen days, at the end of which time she deserted and the eggs found to be infertile. In 1928 three nests were successfully hatched— a record for the county.

Montagu's Harrier (*Circus pyargus*).—Eight nests in 1924 (record) ; six in 1926 ; one in 1927 ; two, and possibly three, in 1928.

Red-footed Falcon (*Falco vespertinus*).—A male in first summer plumage was found by A. P. Meiklejohn in a keeper's " larder" at Bayfield, July 5th, 1927 ; it had probably been there about a month (" British Birds," Vol. XXI., p. 248).

Osprey (*Pandion haliaetus*).—Continues to visit the Broads district in most years on its northward (spring) migration.

Whooper Swan (*Cygnus cygnus*).—Attempted to breed in 1928. A pair of swans were seen by a keeper to be building a nest at the foot of a willow tree in a small mere on the Merton Estate in mid-March. They were recognized as being Whoopers by H. Wormald. One left early in April, and the remaining bird, which had an injured foot though with unimpaired flight, remained until the end of May. It was seen twice by S. H. L., and on May 17th the nest was examined by B. B. R. and found to be empty. Early in June A. W. Boyd saw a Whooper on a neighbouring mere, probably the same bird.

Garganey (*Querquedula querquedula*).—1928 was an exceptional year for this species in Norfolk. About eight pairs bred in the Hickling-Horsey district, four to five pairs at Ranworth and one pair, for the first time, on the Cley marshes.

White-eyed Pochard (*Nyroca nyroca*).—A female was killed in a duck shoot at Hickling, November 24th, 1927 (" British Birds," Vol. XXI., p. 249).

Paget's Pochard.—A male was shot at Hickling, November 3rd, 1928. This is the sixth or seventh that has been recorded for the county, and all have been males (" British Birds," Vol. XXII., p. 250).

Surf-Scoter (*Œdemia perspicillata*).—A flock of seven were seen off Scolt Head Island by Miss E. L. Turner, October 2nd, 1925 (" British Birds," Vol. XIX., p. 243). First record for Norfolk. Three drakes were seen off Hemsby by Miss J. Ferrier, November 16th, 1927 (" British Birds," Vol. XXI., p. 249).

Little Bittern (*Ixobrychus minutus*).—On May 10th, 1928, Major S. W. Trafford had a close view of one, three times, on his marshes at Wroxham.

Bittern (*Botaurus stellaris*).—Is now well established and gradually extending its range. In 1928 one was heard, for the first time, booming in the Yare valley.

White Stork (*Ciconia ciconia*).—One appeared on Breydon June 14th, 1927, but left the same night.

Black Stork (*Ciconia nigra*).—One flying over Scolt Head and identified by S. H. L. and others, June 9th, 1924 (" British Birds," Vol. XVIII., p. 287).

Glossy Ibis (*Plegadis falcinellus*).—A small flock visited Norfolk in September, 1926; one shot at Holme, September 11th and one seen at Hickling, September 14th and 16th; one seen on Breydon September 16th and one shot October 7th. Both those killed were immature birds (" British Birds," Vol. XX., p. 264).

Demoiselle Crane (*Anthropoides virgo*).—One, possibly an escape, but full-winged and wild, seen by B. B. R. to fly in from the sea and alight on Wiveton Marsh, where it remained all day on June 17th, 1924. It departed mid-day next day and was not seen again (" British Birds," Vol. XVIII., p. 292).

Red-Necked Phalarope (*Phalaropus lobatus*).—On June 5th, 1927, a female in full nuptial plumage arrived on the Salthouse side of the East Bank, Cley. The bird was very tame and was seen by S. H. L. and several others. On the night of the 6th it was joined by a male, and both birds moved on the next day.

Siberian Pectoral Sandpiper (*Tringa acuminata*).—The following two Norfolk-killed Pectoral Sandpipers, both formerly recorded as of the American form (*T. maculata*), have been recently examined by B. B. R. and found to be of the Siberian species. The one, now in the Norwich Museum and formerly in Stevenson's collection, was killed at Caistor, September 16th, 1865 " Birds of Norfolk," Vol. II., p. 368), a note regarding which appeared in " British Birds," Vol. XXII., p. 328; the other, now in the King's Lynn Museum, was killed on Terrington Marsh on January 9th, 1868 (" Birds of Norfolk," Vol. II., p. 368). Both these specimens

have been shown to Mr. H. F. Witherby, who agrees with the identification in each case. These bring the number of this species that has been recorded for the British Isles to four, all of which have been obtained in Norfolk.

RUFF (*Machetus pugnax*).—Visits the Broads district regularly on migration; occasionally seen at Cley.

KENTISH PLOVER (*Ægialitis alexandrina*).—One was shot at Blakeney on December 30th, 1927, and picked out from a number of other small waders in the bag by Mr. Edward Ramm ("British Birds," Vol. XXI., p. 263).

ROSEATE TERN (*Sterna dougalli*).—In 1924 one pair bred on Scolt Head Island. In 1925 one pair again nested on Scolt Head and two pairs on Blakeney Point. In 1926 there was one nest on Blakeney Point; in 1927 two nests; in 1928 one nest.

GULL-BILLED TERN (*Sterna anglica*).—On May 17th, 1925. S. H. L. watched one feeding from the surface of Langmere, and four were independently identified by A. H. Patterson on Breydon Water the same day ("British Birds," Vol. XIX., p. 245).

SANDWICH TERN (*Sterna sandvicensis*).—There are now three established colonies: at Salthouse Broad, Blakeney Point and Scolt Head Island. The largest number bred at Salthouse in 1924, at Scolt Head in 1925 and 1926 and at Blakeney Point in 1927 and 1928. In 1928 a conservative estimate put the number breeding at Blakeney at 1,000 pairs.

ROCK-DOVE (*Columba livia*).—One, the first specimen correctly identified in Norfolk was picked up dead, with a wound in the breast, at Ludham, December 9th, 1925 ("British Birds," Vol. XIX., p. 243).

XIII.

FLORA AND FAUNA OF NORFOLK

Additions to Part IV.—FISHES (Ninth List)

By Arthur H. Patterson

Since the publication of my last list in these Transactions (Vol. XI., p. 592) I have not had any new species to add to the Norfolk list.

Cuckoo Wrasse (*Labrus mixtus*).—Two examples from the Suffolk Coast came into my hands in January, 1925. It has not previously been reported from Suffolk. Lowe refers to it as the Green Wrasse.

Scad or Horse-Mackerel (*Caranx trachurus*).—A large example, which had been taken alive from a pool on Breydon, was brought to me on September 6th, 1929.

Bonito (*Auxis Rocheii*).—An example, 16 inches in length and weighing 4 pounds, was landed at Lowestoft in October, 1927.

Ray's Sea-Bream (*Brama raii*).—During the winter of 1927-28 several were recorded as visitors to our east coast. One, weighing 5 pounds 14 ounces and measuring 23½ inches in length, was stranded in Wells harbour, November 12th, 1927.

Pollack (*Gadus pollachius*).—During the summer of 1928 several young pollacks were drawn up from the river into the intake pipe of the Yarmouth Electric Works. They had assumed the normal colour of the adult fish.

Brill (*Rhombus lævis*).—I have come across two examples of this fish having four black spots running parallel to the base of the surrounding fins.

Turbot (*Rhombus maximus*).—In June, 1928, a turbot was observed swimming in the river Bure, and was captured. It weighed about 9 pounds.

Flounder (*Pleuronectes flexus*).—Several examples of this fish have been taken as high up-river as Horning, Potter Heigham, and Barton Broad.

Sun-Fish (*Orthagoriscus mola*).—One was landed at Yarmouth by a herring drifter in November, 1925; and another, 4 feet 2 inches in length, was washed ashore at Blakeney, December 31st, 1928.

Salmon (*Salmo salar*).—The remains of a male salmon weighing 9 pounds was picked up on the banks of the Yare, near Hardley Cross, in October, 1925. A large piece had been eaten out of the back, probably by an otter.

Porbeagle Shark (*Lamna cornubica*).—An example, 8½ feet in length, was brought in in October, 1925. This fish is commonly landed by the herring drifters.

Blue Shark (*Carcharias glaucus*).—One was stranded on the coast a mile north of Caister, October 9th, 1928.

XIV.

MISCELLANEOUS NOTES AND OBSERVATIONS

Some New Plant Records from North and West Norfolk

Cardamine flexuosa With.—N. Wooton.

Nasturtium officinale R.B. var *siifolium* (Reichb).—Cley.

Alyssum incanum Linn.—Whittington, by the roadside.

Hypericum dubium Leers.—N. Wootton, Congham, Bawsey.

Trifolium hybridum Linn.—N. Wootton, Leziate, Saxlingham, Holt.

Petasites fragrans Presl.—Well established in a wood near Weybourne ; also occurs at Holt.

Crepis taraxacifolia Thuill.—Weybourne.

Monotropa Hypopitys Linn.—Holt ; abundant in a large conifer plantation.

Myosotis sylvatica Hoffm.—Holt.

Lamium maculatum Linn.—Kelling, as an escape.

Tragopogon porrifolium Linn.—Weybourne.

Potentilla procumbens Sibth.—S. Wootton.

Salix purpurea Linn.—Hillington.

S. triandra Linn.—N. Wootton, Hillington, Castle Rising.

(Neither of these willows is recorded from division (4) in the Flora).

Aceras anthropophora Br.—Holt district.

Goodyera repens Br.—Holt ; abundant.

Carex curta Good.—Setch.

var. *tenuis* Lang.—N. Wootton ; this was sent to Mr. A. Bennett for identification and constitutes a new record for the county. There is one other station in England.

C. axillaris Good.—N. Wootton.
C. divisa Huds.—N. Wootton.
Apera interrupta Beauv.—N. Wootton.
Pilularia globulifera Linn.—E. Winch, Roydon ; abundant in the dry summer of 1929.—C. P. Petch.

Summer Arrival of the Green Sandpiper.—Captain L. W. Lloyd has the following records of the dates of arrival of the Green Sandpiper (*Totanus ochropus*) at Taverham Mill, on the river Wensum, about five miles above Norwich.

1923, July 10th ; 1924, August 30th ; 1925, August 6th ; 1926, July 3rd ; 1927, July 17th ; 1928, July 10th ; 1929, July 18th.

Mr. H. E. S. Upcher has sent a specimen of Amsinckia Lycopsoides from Sheringham, which has been placed for reference in the herbarium of the University of Leeds. Writing under date of July 8th, 1928, he says :— " I enclose a flower for you to chronicle as growing in Norfolk. There are quite a lot of them round one of my manure heaps. I had never seen a yellow Borage so sent it to Kew. They say it is *Amsinckia lycopsoides* (a native of California). I had some barley meal made of foreign barley and fed it to my pigs. Is this the way it got here ? "

Thirteen seeds from the specimen were sown in pots to test their vitality ; ten germinated, and the seedlings are now in the open garden in Horsforth, looking a healthy colour in early December. It seems advisable to note the occurrence of these aliens as some will become established, and their early history is difficult to trace. Amsinckia is a North American annual with yellow flowers and hairy leaves belonging to the Borage family. It has been seen in Yorkshire and Lancashire since 1913 and probably earlier.—W. H. Burrell.

XV.

WALTER RYE

1843—1929

By the death of Walter Rye, which took place in Norwich on February 24th, 1929, in his 86th year, the Norfolk and Norwich Naturalists' Society has lost a distinguished member, who joined the Society in 1901.

He was born in London in 1843, and was the seventh child of Edward Rye, a London solicitor. At the early age of fourteen he entered his father's office at 16, Golden Square, Westminster, where he served his articles, and became qualified as a solicitor in 1866. He retired in 1900, leaving the business in the hands of his two sons. From that date to his death he resided in Norfolk. He was buried at Lammas, in which village he lived for many years after his retirement.

In trying to describe Walter Rye we think we cannot do better than quote from an appreciation of him, written in 1919, by his friend the late W. G. Clarke, to whose pen the Transactions of this Society are indebted for many valuable papers.

"It is possible to deal with Mr. Walter Rye's athletic prowess by tabulating records, dates, and times; with his amazing industry as an antiquary and genealogist by a recapitulation of the titles of his books, and of the number of entries in his marvellous indices; and of his public work as Mayor of Norwich, and on the Museum and Public Library Committees by a summary of his activities. But all this would not picture him as a man, would not disclose his amazing vitality, grim humour, capacity for hatred and friendship, his absolute lack of snobbery, and his virile personality. When the announcement was made of his acceptance of the Mayoralty of Norwich one of his friends wrote 'that Mr. Rye's qualities are not altogether of the kind usually associated with Mayoralty.' He continued:—'Mr. Rye is a brilliant and scholarly controversialist, a born fighter, full of unconventional surprises; whose genial presence is a very personification of the robust zest of life; a hater of shams and pretentiousness, with always something of the Homeric about whatever he says or does.'

This ' robust zest of life ' was, perhaps, his chief characteristic. This was partly owing to his great physical strength, which he attributed to inherited vitality as the average age of the last ten of his progenitors was seventy-six. When a boy in his father's solicitor's office in London he used to walk home the three and a third miles to Chelsea in half-an-hour, and his favourite Sunday evening walk was one of twenty-four miles. As a lad he walked thirty-seven miles into Surrey on a bitterly cold day, with six cold mutton sandwiches and a bottle of lemonade as his only refreshment. His longest walk in one day was eighty-six miles, and one Boxing Day he walked from Norwich to Swaffham and back. Almost every nook of the Norfolk Broads was known to him years before they became a popular playground.

His amazing energy found outlets in various directions. He started antiquarian work at seventeen, and continued it all his life. His output was enormous ; no other man has ever written, or is likely to write, so much about Norfolk, and, like Bernard Shaw, his " prefaces " were often more piquant than his books. There was little of the wild life of the countryside about which he did not know something. In his youth he collected beetles, butterflies and mollusca. His brother, E. C. Rye, was the author of " British Beetles, an introduction to the Study of our Indigenous Coleoptera," published in 1886, and still a useful text book. Walter did not follow his brother's pursuit, but he had a good knowledge of entomology, and the report—unfounded as it proved—a few years ago, that the Large Copper had been seen near Horning aroused all his youthful enthusiasm. In his later years he made pilgrimages to Foxley Wood to see the Purple Emperor, and stayed out night after night with the late R. J. W. Purdy to see the luminous owl. Birds he knew and loved. His greatest ornithological treat he considered the presence of a hoopoe on his pasture at Lammas twice in 1907. Although he spent months on the Broads at all seasons of the year he had only twice seen a live otter, once on Wroxham Broad on a Christmas Day, when he saw two, and once on Beverley Brook. He was a capable gardener, with a wide knowledge of wild flowers, some of the rarer species of which he carefully tended in his gardens at St. Leonard's House and

Surrey Street, Norwich, and in his charming country residence at Lammas.

Rectory Cottage, Lammas, is probably the spot with which most of the friends he made after his retirement from the profession of a solicitor in London, will associate Walter Rye in memory. Here, almost every week-end he was the host for men of diverse temperaments and of different walks in life—teachers, tailors, auctioneers, farmers, librarians, journalists, and the like. He had transformed the Rectory Cottage and the village schoolroom into a commodious dwelling. The long schoolroom was the dining room, and with the partially-stained windows, peat fire, and furnishings which evidenced the taste of a cultured antiquary; a host who was a brilliant raconteur, with a keen sense of humour, a strong character, and an unequivocal method of expression, there is little wonder that the after-dinner talk often continued until the small hours. In matters of food Mr. Rye had epicurean tastes, sometimes verging on the bizarre. He believed that almost every animal, bird, fish or plant was edible, if sufficient imagination and industry were brought to bear on its cooking. With the help of an able coadjutor he was almost invariably successful in proving his thesis. Many a bird of the heath, the marsh, and the mudflats, usually considered uneatable, was made a delicacy. In his earlier days he once ate a whole emu's egg, given to him by Mr. Peek, of Peek, Frean & Co.

His epicurean tastes did not include clothes, or rather he believed that they should be included with old wine, old friends, and old books, as better than new. This disregard of the convenances respecting dress is said to have been the reason that the Mayor of Norwich was Walter Rye when King Edward came to the city, and Walter Rye when he left. If there was any man to whom this was a matter of indifference it was probably the Mayor. I saw him put on the Mayoral robes on November 9th, 1908, and it was a very unhappy man who tried to squeeze his bulk into the robes removed by his predecessor. Civic life had no attractions for him, and during the first week-end of his Mayoralty which I spent with him at Lammas, he told me that but for the respite afforded by his country residence he would never have accepted the

honour. Yet no man worked harder to fulfil the duties of the office during his year of Mayoralty.

In politics he was a Tory, in religion a Churchman, but was of too independent a type of mind to be bound by the shibboleths of one creed or the other. What he considered strict Toryism would often have met with the approval of the most advanced Socialist. He objected to temperance reform, but would cheerfully have hanged all brewers. With many parts of England he had a most intimate acquaintance, particularly the Norfolk Broads and coast, and North Hampshire, but I believe the only time he was on the Continent was on a professional visit to Paris. On that occasion he went by train from London to Newcastle, thence straight to Paris, where he only stayed an hour or two, in which he secured the desired documents, returned to Newcastle and back to London, without any rest except such as he got in the trains. To all general workers on archæological and genealogical subjects he was a generous friend, giving freely of his vast stores of knowledge and of the benefit of his wonderful indices, but his language regarding the many rich people who wrote to him asking for full particulars of their family tree to be furnished gratis, was vigorous to the extreme. He was a nervous lecturer, even with the aid of lantern slides, but a good after-dinner speaker, in proof of which may be cited his speech at the annual dinner of the Scots Society at St. Andrew of Norwich in 1907.

His Christmas greeting for 1913 was characteristic of the man :—

To those he Liketh—The Inditer
A Merry Christmas sends.
A New Year happier and brighter
Than that which Wednesday ends.
To those he Hates—much Zoedone
And Scraggy Spinsters' kisses,
And Indigestion, weird and wild
(a Thing in which no Bliss is),
And after dinner (Slow and Cold)
Some good old Weary Bore
To drone Stale Stories in his ear
He oft hath heard Before.

Mr. Rye claimed to be the originator of the expressions, "Common or Garden" and "Obstacle race," as he indubitably was the "Father of paper-chasing," which he introduced as an open sport in 1867.

Walter Rye was a fine type of Englishman, with varied tastes, a remarkable combination of athlete, naturalist and antiquary."

CANON JOHN ALFRED LAURENCE
1836—1929

With the death of Canon Laurence, which took place on August 12th, 1929, in his ninety-fourth year, at Dilham Vicarage, Norfolk, our Society has lost one of its three remaining original members.

Born in 1836 John Alfred Laurence, after taking his degree at Cambridge as a *Junior Optime* in 1859, was ordained in 1860, and appointed to his first and only curacy, at Bergh Apton, Norfolk, which he held for twelve years, and was then appointed in 1872, vicar of Dilham and Honing, which incumbency he held up to the time of his death. In 1922, when he had completed fifty years at Dilham, an honorary canonry of Norwich cathedral was conferred upon him for his "unassuming, genuine and diligent work in a somewhat isolated spot."

To within a year or so of his death he was a fairly regular attendant at our monthly meetings, though he never contributed anything to our Transactions. Canon Laurence was never married. He was buried in Dilham churchyard.

GEOFFREY FOWELL BUXTON, C.B., F.Z.S.
1852—1929

It is with deep regret that we have to record the death of Geoffrey Fowell Buxton, which occurred at his residence, Hoveton Hall, Norfolk, on April 11th, 1929. Although not an original member, he joined the Society in 1874 and at the time of his death was the fourth oldest surviving member.

Born at Leytonstone in 1852 Geoffrey F. Buxton was the grandson of Sir Thomas Fowell Buxton, the first baronet, and second son of Thomas Fowell Buxton. He was educated at Uppingham and at Trinity College, Cambridge, where he took his degree in 1874. Soon afterwards he joined the old

Geoffrey Fowell Buxton

1852—1929

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Gurneys Bank in Norwich, and after the absorption of this bank by Barclays he became a director of the latter, which position he held up to the time of his death.

Always a public-spirited man he served as Sheriff of Norwich in 1890-1, and as Mayor in 1903-4. For many years he served with the 1st Volunteer Battalion of the Norfolk Regiment, from which he retired with the honorary rank of lieutenant-colonel. When the Norfolk Imperial Yeomanry were started he was made second in command. In all forms of sport he took great interest, and for many years was master of the Dunstan harriers. He was ever ready to assist in the work of this Society and our library is indebted to him for the gift of many volumes. He showed his interest in the formation of the Norfolk Naturalists Trust by becoming one of its first life-members. Quiet and unassuming of manner he was a splendid example of the English country gentleman and will be missed by a very large circle of friends.

He married in 1878 Mary, the eldest daughter of the Rev. the Hon. John Harbord, rector of Southrepps, who survives him, together with two sons and five daughters. He was buried in the churchyard of Hoveton St. Peter, Norfolk.

EDWARD GURNEY BUXTON

1865—1929

WITHIN ten days of the death of his second cousin, Geoffrey Buxton, there passed away, suddenly, at Barclays Bank, Norwich, on April 19th, 1929, Edward Gurney Buxton, of Catton Hall, Norfolk, and it is with much regret that we have to record his death in this same issue of our Transactions.

Born in 1865, Edward Gurney Buxton was the eldest son of Samuel Gurney Buxton, of Catton Hall, and a grandson of Sir Thomas Fowell Buxton, the first baronet. He was educated at Harrow and at Trinity College, Cambridge, and at the age of nineteen entered Gurney's Bank, Norwich, with which he was associated for the rest of his life, having been elected a director of Barclays Bank on the death of his father.

In 1907 he followed in the footsteps of his father by becoming Mayor of Norwich, and in the business life of the city occupied a prominent position as director of various companies. He was passionately fond of cricket and from 1890 to 1909 was honorary

secretary of the Norfolk County Club, for which he worked hard to raise it to the level of the second class counties. In 1926 he was elected president of the club. He was a good shot and a skilled fisherman, and for many years he went to Scotland for salmon fishing. He became a member of this Society in 1887, and although he never took any active part in its affairs he was interested in its work.

He married Laura, the daughter of John Gurney of Sprowston Hall, who survives him with five sons and six daughters. He was buried at Old Catton.

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MEMBERSHIP

The Society consists of two classes of Members, viz., Ordinary and Honorary Members.

Ordinary Members proposed and seconded at any meeting of the Society are balloted for at the next meeting. The Annual Subscription is 10s., payable in advance on election, subsequent subscriptions becoming due on the last Tuesday in March annually. This subscription may be compounded for by a single payment of £8.

Ladies or Gentlemen distinguished for their attainments in Natural Science, or who have rendered valuable services to the Society, may be nominated by the General Committee as Honorary Members, and elected by a show of hands at the next meeting of the Society. Such Honorary Members have all the privileges of Ordinary Members.

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